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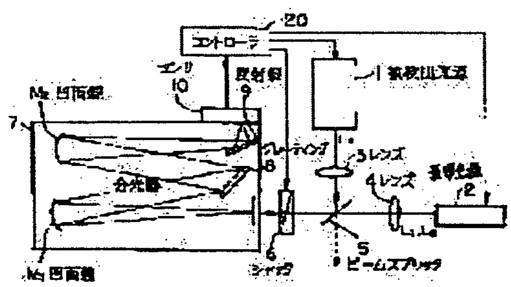
(54) DETECTING APPARATUS FOR WAVELENGTH

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a detecting apparatus by which a wavelength can be detected with good accuracy and without any error even when the characteristic of a spectroscope is changed by a method wherein a plurality of beams of reference light whose wavelengths are different are emitted as beams of reference light by a reference light source and the characteristic value of the spectroscope is computed on the basis of detection positions of the beams of reference light and on the basis of a known wavelength.



SOLUTION: Light Lo to be detected is incident on a beam splitter 5 via a lens 3, and a part is reflected by the splitter 5 so as to be guided to a shutter 6. Reference light Ln and reference light La are incident on the splitter 5 via a leans 4, and a part of the reference light La and a part of the reference light Ln are

transmitted through the splitter 5 so as to be guided to the shutter 6. In this manner, the light Lo to be detected, the reference light Ln and the reference light La are passed through the shutter 6 so as to be incident on a spectroscope 7. When they are incident on the spectroscope 7, they are incident on a concave mirror M1, beams of reflected light are incident on a grating 8, the angle of diffraction of the grating 8 is changed according to their wavelengths, and their incident positions on a senior 10 are different. As a result, the light Lo to be detected, the reference light Ln and the reference light La whose wavelengths are different are spectrally diffracted so as to be incident on the sensor 10, and the respective wavelengths can be detected according to their detection positions on the sensor 10.

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CLAIMS

[Claim(s)]
[Claim 1] A detected light which emits light by the detected light source while inputting into a spectroscope the criteria light which emits light by the criteria light source is inputted into said spectroscope. The detection location of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the characteristic value of said spectroscope, and the known wavelength of said criteria light The detection location of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, The detection location of said criteria [based on the known wavelength of said two or more criteria light, calculate the actual characteristic value of said spectroscope, and] light on said sensor, and said detected light, Wavelength detection equipment which calculated the wavelength of said detected light based on the actual characteristic value of said said calculated spectroscope, and the known wavelength of said criteria light.

[Claim 2] A detected light which emits light by the detected light source while inputting into a spectroscope the criteria light which emits light by the criteria light source is inputted into said spectroscope. The detection location of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the variance of said spectroscope, and the known wavelength of said criteria light The detection location of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, The detection location of said criteria [based on the known wavelength of said two or more criteria light, calculate the actual variance of said spectroscope, and] light on said sensor, and said detected light, Wavelength detection equipment which calculated the wavelength of said detected light based on the actual variance of said said calculated spectroscope, and the known wavelength of said criteria light.
[Claim 3] A detected light which emits light by the detected light source while inputting into a spectroscope the criteria light which emits light by the criteria light source is inputted into said spectroscope. The detection location of the interference fringe of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the known wavelength of said criteria light The detection location of the interference fringe of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, It is based on the known wavelength of said two or more criteria light, and the correspondence relation between the location of the interference fringe on said sensor and the wavelength of the light led to said sensor is calculated. Wavelength detection equipment which calculated the wavelength of said detected light by asking for the wavelength of the light corresponding to the detection location of the interference fringe of said detected light on

said sensor from said calculated correspondence relation.
[Claim 4] Two or more criteria light from which the wavelength which a detected light which emits light by said detected light source is an oscillation laser beam outputted from argon fluorine excimer laser, and emits light by said criteria light source differs is claims 1 or 2 which are the luminescence line of Arsenic As, and the luminescence line of Neon Ne, or wavelength detection equipment given in three.
[Claim 5] Said criteria light source is wavelength detection equipment according to claim 4 which is the arsenic lamp which used Neon Ne as a buffer gas.
[Claim 6] In the wavelength detection equipment which detects the wavelength of a detected light outputted from the detected light source based on the wavelength of the criteria light which emits light by the criteria light source When said detected light is an argon fluorine excimer laser luminescence line, it has the wavelength most approximated to the wavelength of said argon fluorine excimer laser luminescence line. And wavelength detection equipment which used one or more luminescence lines as said criteria light among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed.
[Claim 7] In the wavelength detection equipment which detects the wavelength of said detected light based on the absorption line which makes the minimum optical reinforcement of a detected light outputted from the detected light source The platinum Pt which has the wavelength of said argon fluorine excimer laser luminescence line, and the approximated wavelength when said detected light is an argon fluorine excimer laser luminescence line, Wavelength detection equipment which used the one or more absorption lines as the absorption line to said argon fluorine excimer laser luminescence line among the absorption lines of Arsenic As, Neon Ne, Carbon C, and Germanium germanium.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to suitable wavelength detection equipment to detect the wavelength of the oscillation laser beam of argon fluorine (ArF) excimer laser and krypton fluorine (KrF) excimer laser especially about the wavelength detection equipment which detects the wavelength of light, such as laser.
[0002]
[Description of the Prior Art] To use excimer laser as the light source of a stepper (contraction projection aligner), it is necessary to narrow-band-ize the oscillation laser beam of excimer laser. It is necessary to carry out stabilization control with high precision so that it furthermore may not shift while exposing the main wavelength of the spectrum of this narrow-band-ized oscillation laser beam.
[0003] Drawing 19 is the wavelength stabilization control unit of common laser.
[0004] Narrow-band-ization is performed by driving narrow-band-ized components arranged in the narrow-band-ized module 26, such as an etalon and a grating, through a driver 28 by the controller 20 (an etalon or the installation include angle of a grating being adjusted). During exposure, control of wavelength is made so that the main wavelength of a spectrum may not be changed.
[0005] That is, the absolute wavelength of the oscillation laser beam L0 is detected [in the monitor module 22] by always detecting the relative wavelength of the oscillation laser beam L0 to criteria light during exposure.
[0006] Next, a narrow-band-ized component drives through a driver 28 by feeding back this detection result to a controller 20.
[0007] And the main wavelength of the spectrum of the laser beam L0 which emits light through the laser chamber 27 is fixed to target wavelength.
[0008] In JP,4-163980,A, the luminescence line of arsenic (As) with a wavelength of 193.696nm is used as a criteria light for [of the oscillation laser beam of argon fluorine excimer laser (wavelength of about 193.3nm)] detecting wavelength absolutely.
[0009] Namely, incidence is carried out to a spectroscope by making into criteria light the luminescence line which emits light from an arsenic enclosure discharge lamp. Incidence is carried out to this spectroscope by making into a detected light the oscillation laser beam of the argon fluorine excimer laser which wants to detect wavelength to coincidence. And in a spectroscope, the spectrum of criteria light and the detected light is carried out, and image formation of the image of the light which carried out the spectrum is carried out on a line sensor. The detection location on a line sensor corresponds to detection wavelength.
[0010] And using a variance, from the difference of the detection location on a line sensor, it asks for the relative wavelength of a detected light to criteria light, and the absolute wavelength of a detected light is calculated based on this relative wavelength for which it asked, and the wavelength of a known criteria light.
[0011] A variance is explained here. Drawing 12 shows the sensor channel number (location on a line

sensor) of a line sensor, and the relation of sensor signal strength. The line sensor is equipped with two or more light-receiving channels, and the photodetection location on a line sensor becomes settled according to the channel number which detected the light of the maximum reinforcement. In a line sensor, since the incidence locations to a line sensor differ according to wavelength, the wavelength of light is detectable from the photodetection location of a line sensor. Therefore, the wavelength of light becomes settled from the channel number which detected light.

[0012] A variance is the wavelength (unit nm) equivalent to channel spacing (unit mum) of a line sensor. If a variance (wavelength equivalent to channel spacing of a line sensor) can be defined, it can ask for the relative wavelength of the detected light L0 to the criteria light La from the difference of the channel number Sa which detected the criteria light La using this variance, and the channel number S0 which detected the detected light L0.

[0013] It becomes settled with the property of a spectroscope of channel spacing being equivalent to what wavelength, or (variance) drawing light on a sensor. The property of a spectroscope becomes settled with the characteristic value of the various optical element components which constitute spectroscopes, such as the number of the slots on the grating, a focal distance of a concave mirror, and a rate of optical refraction in air.

[0014] The variance was calculating the wavelength lambda 0 of a detected light as a known value here noting that the property of a spectroscope was known conventionally that is,.

[0015] Specifically based on design values, such as a focal distance of the concave mirror inside a spectroscope, the theoretical variance (on a spectroscope design) Dt (wavelength per sensor) is calculated for every spectroscope.

[0016] And this calculated theoretical variance Dt is fixed, and he asks for the relative wavelength of the detected light L0 to the criteria light La from the difference of the detection channel number Sa of the criteria light La, and the detection channel number S0 of the detected light L0, and was trying to calculate the wavelength lambda 0 of the detected light L0 from known wavelength lambdaa (193.696nm) of this relative wavelength for which it asked, and the criteria light La.

[0017]

[Problem(s) to be Solved by the Invention] However, the characteristic value of the spectroscope on a design differs from the characteristic value of each actually manufactured spectroscope a little. That is, the error is included in the theoretical variance Dt by the individual difference of a spectroscope.

[0018] moreover, the property of a spectroscope -- change of temperature, and the change equimeasure of a pressure -- a law -- it changes according to an environmental change. For example, when temperature changes, spacing of the slot on the grating changes. Moreover, change of a pressure changes the rate of optical refraction in air. For this reason, the relation between the detection location of a sensor and wavelength is changed by change of temperature and a pressure.

[0019] Originating in fluctuation of the property of the spectroscope by the difference between the property of the spectroscope on a design, and the property of each actually manufactured spectroscope, and fluctuation of a measurement environment etc. as mentioned above, the actual variance D of a spectroscope shows a different value in the theoretical variance Dt. Therefore, noting that the property of a spectroscope is known (i.e., ****** [the theoretical variance Dt is known]) It asks for the relative wavelength of the detected light L0 to the criteria light La from the difference of the detection channel number Sa of the criteria light La, and the detection channel number S0 of the detected light L0. When this relative wavelength for which it asked, and the wavelength lambda 0 of known wavelength lambdaa (193.696nm) of the criteria light La to the detected light L0 are calculated, a detection error will be included in this wavelength lambda 0 for which it asked. Although wavelength lambda 0 is asked for the detection precision of 0.0001nm order, it cannot respond to this request.

[0020] Even if this invention is made in view of such the actual condition, and individual difference is in a spectroscope, or you change a measurement environment and the property of a spectroscope changes, let it be a solution technical problem to enable it to detect the wavelength of a detected light outputted from the detected light source with a without error and sufficient precision.

[0021]

[Means for Solving the Problem and its Function and Effect] Then, a detected light which emits light according to the detected light source in the 1st invention of this invention while inputting into a spectroscope the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem is inputted into said spectroscope. The detection location of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the characteristic value of said spectroscope, and the known wavelength of said criteria light The detection location of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, The detection location of said criteria [based on the known wavelength of said two or more criteria light, calculate the actual characteristic value of said spectroscope, and] light on said sensor, and said detected light, He is trying to calculate the wavelength of said detected light based on the actual characteristic value of said said calculated spectroscope, and the known wavelength of said criteria light.

[0022] Moreover, a detected light which emits light according to the detected light source in the 2nd invention while inputting into a spectroscope the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem is inputted into said spectroscope. The detection location of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the variance of said spectroscope, and the known wavelength of said criteria light The detection location of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, The detection location of said criteria [based on the known wavelength of said two or more criteria light, calculate the actual variance of said spectroscope, and] light on said sensor, and said detected light, He is trying to calculate the wavelength of said detected light based on the actual variance of said said calculated spectroscope, and the known wavelength of said criteria light.

[0023] Moreover, a detected light which emits light according to the detected light source in the 3rd invention while inputting into a spectroscope the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem is inputted into said spectroscope. The detection location of the interference fringe of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the known wavelength of said criteria light The detection location of the interference fringe of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, It is based on the known wavelength of said two or more criteria light, and the correspondence relation between the location of the interference fringe on said sensor and the wavelength of the light led to said sensor is calculated. He is trying to calculate the wavelength of said detected light by asking for the wavelength of the light corresponding to the detection location of the interference fringe of said detected light on said sensor from said calculated correspondence relation.

[0024] Moreover, in the 4th invention, in the 1st invention of the above, the 2nd invention, and the 3rd invention, a detected light which emits light by said detected light source is an oscillation laser beam outputted from argon fluorine excimer laser, and two or more criteria light from which the wavelength which emits light by said criteria light source differs supposes that they are the luminescence line of Arsenic As, and the luminescence line of Neon Ne.

[0025] Moreover, in the 5th invention, said criteria light source supposes that it is the arsenic lamp which used Neon Ne as a buffer gas in the 4th invention of the above.

[0026] The 1st invention of the above is made to correspond to drawing 1 and drawing 2 , and is explained.

[0027] That is, according to the 1st invention, two or more criteria light Ln and La from which

wavelength lambdan and lambdaa differ as a criteria light by the criteria light source 2 emits light.
[0028] And based on the detection locations Sn and Sa of two or more criteria light Ln and La on a sensor 10, and known wavelength lambdan of two or more criteria light Ln and La and lambdaa, the actual characteristic value D of a spectroscope 7 calculates (D=(lambdaa-lambdan)/(Sa-Sn)).
[0029] And based on the detection locations Sn and S0 of the criteria light Ln on a sensor 10, and the detected light L0, and the actual characteristic value D of a spectroscope 7 and known wavelength lambdan of the criteria light Ln by which the operation was carried out [above-mentioned], the wavelength lambda 0 of the detected light L0 calculates (lambda0=lambdan+ (S0-Sn) and D).
[0030] "The actual characteristic value of a spectroscope" of the 1st invention is a concept including characteristic values other than Variance D. It is a concept including characteristic values, such as the focal distance f of the concave mirror M2 inside a spectroscope, and the slot number consistency N of a grating 8, (refer to (3) types of an operation gestalt - (11) types).
[0031] Moreover, according to the 2nd invention, two or more criteria light Ln and La from which wavelength lambdan and lambdaa differ as a criteria light by the criteria light source 2 emits light.
[0032] And the actual variance D of a spectroscope 7 calculates based on the detection locations Sn and Sa of two or more criteria light Ln and La on a sensor 10, and known wavelength lambdan of two or more criteria light Ln and La and lambdaa (D=(lambdaa-lambdan)/(Sa-Sn)).
[0033] And based on the detection locations Sn and S0 of the criteria light Ln on a sensor 10, and the detected light L0, and the actual variance D of a spectroscope 7 and known wavelength lambdan of the criteria light Ln by which the operation was carried out [above-mentioned], the wavelength lambda 0 of the detected light L0 calculates (lambda0=lambdan+ (S0-Sn) and D).
[0034] Since the actual characteristic value (variance D) of a spectroscope 7 is calculated and the wavelength lambda 0 of the detected light L0 is calculated based on this actual characteristic value (variance D) according to the 1st invention and the 2nd invention as mentioned above Even if individual difference is in a spectroscope 7, or a measurement environment carries out fluctuation etc. to it and the property of a spectroscope 7 changes to it, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0035] The 3rd invention is made to correspond to drawing 10 and drawing 11 , and is explained.
[0036] That is, according to the 3rd invention, two or more criteria light Ln and La from which wavelength lambdan and lambdaa differ as a criteria light by the criteria light source 2 emits light.
[0037] And it is based on the detection locations Rn and Ra of the interference fringes 19b and 19a of two or more criteria light Ln and La on a sensor 18, and known wavelength lambdan of two or more criteria light Ln and La and lambdaa, and the correspondence relation Q with the wavelength lambda of the light led to the location R2 and sensor 18 of an interference fringe on a sensor 18 calculates (refer to drawing 11).
[0038] And the wavelength lambda 0 of the detected light L0 calculates by asking for the wavelength lambda 0 of the light corresponding to the detection location R0 of interference fringe 19c of the detected light L0 on a sensor 18 from the correspondence relation Q by which the operation was carried out [above-mentioned].
[0039] Also in **** 3 invention, since the actual correspondence relation Q with the wavelength lambda of the light led to the location R2 and sensor 18 of an interference fringe on a sensor 18 is correctly called for even if individual difference is in a spectroscope, or it changes a measurement environment to it and the property of a spectroscope changes to it, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0040] Moreover, according to the 4th invention, as shown in drawing 2 , the luminescence line Ln of wavelength lambdan=193.00345nm [with wavelength smaller than the wavelength lambda0=193.3nm detected light (oscillation laser beam of argon fluorine excimer laser) L0] neon Ne and the luminescence line La of wavelength lambdaa=193.7590nm arsenic As with larger wavelength than the **** detection light L0 are used as a criteria light. Thus, since the wavelength lambda 0 of the detected light L0 exists between wavelength lambdan of two criteria light Ln and La, and lambdaa, it can ask for the wavelength lambda 0 of the detected light L0 with a sufficient precision with interpolation.

[0041] Moreover, according to the 5th invention, as shown in drawing 1 , the criteria light source 2 is used as the arsenic (As) lamp which used Neon Ne as a buffer gas.
[0042] Thus, according to the 5th invention, light can be emitted in two criteria light Ln (neon) and La (arsenic) from the one criteria light source 2, and it is not necessary to prepare the two criteria light sources separately.
[0043] Moreover, it sets to the wavelength detection equipment which detects the wavelength of a detected light outputted from the detected light source in the 6th invention based on the wavelength of the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem. When said detected light is an argon fluorine excimer laser luminescence line, he has the wavelength most approximated to the wavelength of said argon fluorine excimer laser luminescence line, and is trying to use one or more luminescence lines as said criteria light among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed.
[0044] The 6th invention of the above is made to correspond to drawing 13 , and is explained.
[0045] That is, according to the 6th invention, it has the wavelength most approximated to the wavelength of an argon fluorine excimer laser luminescence line as a criteria light of the criteria light source, and one or more luminescence lines are used among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed.
[0046] Here For example, when three luminescence lines LP1, LP2, and LP3 of the platinum Pt which has the wavelength approximated most in the wavelength lambda 0 of the detected light L0 of argon fluorine excimer laser as shown in drawing 13 are used as a criteria light, Based on the wavelength lambdaP1 of the criteria light LP1, LP2, and LP3 on a sensor 10, lambdaP2, and lambdaP3, the wavelength lambda 0 of the detected light L0 is detected.
[0047] Thus, since according to the 6th invention it has the wavelength most approximated to the wavelength of an argon fluorine excimer laser luminescence line and uses as one or more luminescence line standard light among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed, the wavelength lambda 0 of the detected light L0 is detectable.
[0048] Even if individual difference is in a spectroscope 7 by this, or a measurement environment carries out fluctuation etc. and the property of a spectroscope 7 changes, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0049] Moreover, it sets to the wavelength detection equipment which detects the wavelength of said detected light in the 7th invention based on the absorption line which makes the minimum optical reinforcement of a detected light outputted from the detected light source in order to attain the above-mentioned solution technical problem. The platinum Pt which has the wavelength of said argon fluorine excimer laser luminescence line, and the approximated wavelength when said detected light is an argon fluorine excimer laser luminescence line, He is trying to use the one or more absorption lines as the absorption line to said argon fluorine excimer laser luminescence line among the absorption lines of Arsenic As, Neon Ne, Carbon C, and Germanium germanium.
[0050]
[Embodiment of the Invention] The wavelength detection equipment applied to this invention with reference to a drawing below is explained.
[0051] With this operation gestalt, the case where the wavelength of argon fluorine (ArF) excimer laser is detected is assumed. However, also when detecting the wavelength of krypton fluorine (KrF) excimer laser, it can apply. The wavelength of krypton fluorine excimer laser is about 248.4nm. The wavelength of argon fluorine excimer laser is about 193.3nm. Moreover, it is applicable also to detection of the wavelength of light other than a laser beam.
[0052] Drawing 1 shows the configuration of the wavelength detection equipment of an operation gestalt.
[0053] The detected light source 1 is the light source by which the detected light L0 which wants to detect wavelength is injected, and is argon fluorine excimer laser equipment with this operation gestalt. The laser beam oscillated by carrying out discharge excitation by the laser chamber of argon fluorine

excimer laser equipment is amplified by carrying out both-way migration of the inside of the resonator which the front mirror 21 and the narrow-band-ized module 26 constitute, and is injected as an oscillation laser beam L0 of predetermined power from a laser ejection aperture.
[0054] On the other hand, the criteria light source 2 is an arsenic (As) lamp with which Neon Ne is enclosed as a buffer gas. In addition, the buffer gas is enclosed in the lamp so that the filament of a lamp may not burn. As for an arsenic lamp, a hollow cathode lamp is used. Therefore, from the criteria light source 2, the luminescence line Ln of neon Ne with a wavelength of 193.00345nm and the luminescence line La of arsenic As with a wavelength of 193.7590nm emit light as criteria light Ln and La which is two from which wavelength differs. Therefore, according to this operation gestalt, the advantage that light can be emitted in two criteria light Ln (neon) and La (arsenic) is acquired from the one criteria light source 2. It is not necessary to prepare the two criteria light sources separately.
[0055] Incidence of the detected light L0 is carried out to a beam splitter 5 through a lens 3. It is reflected by the beam splitter 5 and a part of detected light L0 is led to a shutter 6. Incidence of the criteria light Ln and La is carried out to a beam splitter 5 through a lens 4. A part of criteria light Ln and La penetrates a beam splitter 5, and it is led to a shutter 6.
[0056] In this way, the detected light L0 and the criteria light Ln and La pass a shutter 6, and incidence is carried out into a spectroscope 7.
[0057] If incidence of the detected light L0 and the criteria light Ln and La is carried out to a spectroscope 7, incidence will be first carried out to a concave mirror M1, and incidence will be carried out to the grating 8 whose reflected light is a diffraction grating. According to the wavelength of the light by which incidence is carried out, whenever [angle-of-diffraction / of a grating 8] changes. Incidence of the detected light L0 and the criteria light Ln and La which were diffracted by the grating 8 is carried out to a concave mirror M2, and the reflected light is led to a sensor 10 through a reflecting mirror 9.
[0058] As for a sensor 10, a line sensor is used. Specifically, it can constitute using a single dimension, 2-dimensional image sensors, or a diode array.
[0059] If the wavelength of the light by which incidence is carried out to a spectroscope 7 differs, whenever [in a grating 8 / angle-of-diffraction] differ, and the incidence locations to a sensor 10 differ. The spectrum of the detected light L0 and the criteria light Ln and La from which wavelength differs to a sensor 10 as a result is carried out, and they can detect each wavelength lambda 0 of the detected light L0 by which incidence was carried out and incidence was carried out to the spectroscope 7 according to the detection location on a sensor 10, and the criteria light Ln and La, lambdan, and lambdaa. That is, the spectrum profile on a line sensor changes with the wavelength of light. In addition, when an etalon is used instead of a grating, the fringe pattern on a line sensor changes.
[0060] A spectroscope 7 may be made to carry out incidence of the criteria light Ln and La which emitted light by the criteria light source 2, and the detected light L0 which emitted light by the detected light source 1 to coincidence, criteria light and a detected light may be shifted in time, and incidence may be carried out to a spectroscope 7.
[0061] With this operation gestalt, the case where the excimer laser equipment of the detected light source 1 is used as the light source of a stepper (contraction projection aligner) is assumed. In this case, it is necessary to narrow-band-ize the oscillation laser beam L0 of excimer laser. It is necessary to carry out stabilization control with high precision so that it furthermore may not shift while exposing the main wavelength of the spectrum of this narrow-band-ized oscillation laser beam L0.
[0062] Narrow-band-ization is performed by driving narrow-band-ized components arranged in the resonator of a laser chamber, such as an etalon and a grating, (an etalon or the installation include angle of a grating being adjusted). During exposure, control of wavelength is made so that the main wavelength of a spectrum may not be changed.
[0063] For this reason, the absolute wavelength lambda 0 of the oscillation laser beam L0 is detected during exposure by the wavelength detection equipment shown in drawing 1 by always detecting the relative wavelength of the oscillation laser beam L0 to the criteria light Ln and La. And by feeding back this detection result, a narrow-band-ized component drives and the main wavelength of the spectrum of

the oscillation laser beam L0 is fixed to target wavelength.
[0064] A controller 20 performs fixed control of the wavelength which performs wavelength detection processing shown in drawing 3 mentioned later, and mentions it above based on the obtained wavelength detection result.
[0065] The principle applied to this operation gestalt here is explained.
[0066] Drawing 2 shows channel number S (location on a line sensor) of a sensor 10, and the relation of sensor signal strength. The sensor 10 is equipped with two or more light-receiving channels, and the photodetection location on a line sensor becomes settled according to the channel number which detected the light of the maximum reinforcement. In a line sensor, since the incidence locations to a line sensor differ according to wavelength, the wavelength of light is detectable from the photodetection location of a line sensor. Therefore, the wavelength of light becomes settled from the channel number which detected light.
[0067] If the variance D of a spectroscope 7 (wavelength equivalent to channel spacing of a line sensor 10) can be defined here, the difference of the channel numbers Sn or Sa which detected the criteria light Ln or La using this variance D, and the channel number S0 which detected the detected light L0 is convertible for the relative wavelength of the detected light L0 to the criteria light Ln or La. And the wavelength lambda 0 of the detected light L0 can be calculated from known wavelength lambdan (= 193.00345nm) or lambdaa (= 193.7590nm) of this relative wavelength for which it asked, and the criteria light Ln or La.
[0068] With this operation gestalt, in consideration of changing the variance D of the above-mentioned spectroscope 7 according to fluctuation of a measurement environment etc., the actual variance D is calculated and it is characterized by the point of calculating the wavelength lambda 0 of the detected light L0 based on this calculated actual variance D. With reference to the flow chart shown in drawing 3 below, it explains concretely.
[0069] As shown in this drawing 3 , first, a controller 20 makes the shutter 6 of the wavelength detection equipment shown in drawing 1 open, and carries out incidence of the detected light L0 and the criteria light Ln and La to a spectroscope 7 (step 101).
[0070] The output of a sensor 10 is read at the following step 102.
[0071] As shown in drawing 2 , from a sensor 10, the sensor channel numbers Sn, S0, and Sa corresponding to three peaks of sensor signal strength are outputted. Wavelength lambdan of the luminescence line of Neon Ne is lambdan=193.00345nm (inside of a vacuum), wavelength lambdaa of the luminescence line of Arsenic As is lambdaa=193.7590nm (inside of a vacuum) here, and lambda 0 of the luminescence line of the detected light L0 is larger than lambdan, and smaller than lambdaa (lambda0=193.3nm).
[0072] Therefore, let S0 [larger / than channel number Sn which detected the luminescence line of Neon Ne / and smaller than the channel number Sa which detected the luminescence line of Arsenic As] be the channel number which detected the oscillation laser beam L0 (step 102).
[0073] The channel numbers Sn and Sa to which it detected two criteria light Ln and La next as Variance D (wavelength per channel of a sensor 10) showed in following the (1) type, and two criteria light Ln. It calculates using known wavelength lambdan (= 193.00345nm) of La, and lambdaa (= 193.7590nm).
[0074]
D=(lambdaa-lambdan)/(Sa-Sn) -- (1)
Next, the above-mentioned variance D is used, and as the wavelength lambda 0 of the detected light L0 shows in following the (2) type, it is asked for it.
[0075] lambda0=lambdan+ (S0-Sn) and D -- (2)
Namely, the relative wavelength (S0-Sn) and D of the detected light L0 to the criteria light Ln are calculated by carrying out the multiplication of the difference of the channel number S0 which detected the detected light S0, and channel number Sn which detected the criteria light Ln to Variance D. The wavelength lambda 0 of the detected light L0 calculates by adding known wavelength lambdan of the criteria light Ln to this relative wavelength (S0-Sn) and D. In addition, although wavelength lambdan of

Neon Ne and channel number Sn are used by the above-mentioned (2) formula, wavelength lambdaa of Arsenic As and a channel number Sa may instead be used (step 104).
[0076] Since the actual variance D of a spectroscope 7 is calculated and the wavelength lambda 0 of the detected light L0 is calculated based on this actual variance D, even if individual difference is in a spectroscope 7, or it changes a measurement environment and the property of a spectroscope 7 changes according to this operation gestalt as mentioned above, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0077] With the above-mentioned operation gestalt, as shown in the above-mentioned (1) formula, the case where the relation of wavelength lambda to the channel location S of a sensor 10 has an almost linearity relation is assumed.
[0078] When there is next no relation of wavelength lambda to the channel location S of a sensor 10 in linearity relation, a suitable operation gestalt is explained. For example, it uses and is suitable when the width of face per channel of a sensor 10 is not uniform.
[0079] Drawing 4 shows arrangement of the optical system inside the spectroscope at the time of using grating spectroscope 7' of a Czerny-Turner mold instead of a spectroscope 7 in drawing 1 .
[0080] If incidence of the detected light L0 and the criteria light Ln and La is carried out to spectroscope 7' as shown in this drawing 4 , incidence will be first carried out to a concave mirror M1, and incidence of the reflected light will be carried out to a grating 8. The incident angle to a grating 8 is set to alpha. The outgoing radiation angle of a grating 8 changes according to the wavelength of the light by which incidence is carried out. The outgoing radiation angle of the criteria light Ln of wavelength lambdan is set to betan, the outgoing radiation angle of the criteria light La of wavelength lambdaa is set to betaa, and the outgoing radiation angle of the detected light L0 of wavelength lambda 0 is set to beta 0. Incidence of the detected light L0 and the criteria light Ln and La which were diffracted by the grating 8 is carried out to a concave mirror M2, and the reflected light is led to a sensor 10 through a reflecting mirror 9. The focal distance of a concave mirror M2 is set to f (mm).
[0081] By the controller 20, the same processing as steps 101 and 102 is performed.
[0082] However, he makes a spectroscope 7 carry out incidence of the detected light L0 and the criteria light Ln and La to coincidence, and is trying to measure three detection locations on a sensor 10 to coincidence with this operation gestalt. And channel number Sn equivalent to peak core wavelength is calculated by interpolating three channel locations where sensor signal strength serves as a peak. Channel numbers Sa and S0 are called for by the same interpolation.
[0083] And the following processings are performed instead of steps 103 and 104.
[0084] The slot number consistency of a grating 8 is set to N (gr/mm) below, and the order of diffraction of a grating 8 is set to m. Moreover, width of face of per 1ch (channel) of the light-receiving channel of a sensor 10 is set to MCD (mm/ch).
[0085] Then, (3), (4), (5), (following 6), and following (7) type is materialized from the relation between the incident angle of a grating 8, and an outgoing radiation angle.
[0086]
N-m-lambda n=sin alpha+sinbetan -- (3)
N-m-lambda a=sin alpha+sinbetaa -- (4)
N-m-lambda 0=sin alpha+sin beta 0 -- (5)
beta a=beta n+deltabetana=beta n+dna/f -- (6)
beta0=betan+deltabetan0=betan+dn0/f -- (7)
However, they are dna= (Sn-Sa), MCDdn0= (Sn-S0), and MCD.
[0087] Therefore, from (3) type-(4) type, N-m(lambdan-lambdaa) = sinbetan-sinbetaa is obtained and it sets with N-m(lambdan-lambdaa) = sinbetan-sinbetaa=k.
[0088] If (6) types are substituted for this, sinbetan-sin (betan+dna/f) =k2sin (- dna / 2f) and cos (betan+dna / 2f) =k will be obtained. This betan=acos(k/2sin (-dna / 2f))-dna / 2f -- (8)
**********.
[0089] (3) From a formula and (8) types to sin alpha=N-m-lambda n-sinbetan -- (9)
It ******.

[0090] Moreover, it is from (7) types and (8) types. sinbeta0=sin[acos {k/2 and sin(-dna / 2f)-dna / 2f} + dn0/f] -- (10)
It ******.
[0091] therefore -- from (5), (9), and (10) types lambda0=(sin alpha+sin beta 0)/(N-m) -- (11)
Wavelength lambda 0 is computed.
[0092] Also in this operation gestalt, the wavelength lambda 0 of the detected light L0 is detectable with a sufficient precision in consideration of the actual characteristic value of spectroscope 7' as mentioned above.
[0093] As shown in drawing 2 , with the operation gestalt explained above The luminescence line Ln of wavelength lambdan=193.00345nm neon Ne with wavelength smaller than the wavelength lambda0=193.3nm detected light L0, Although the luminescence line La of wavelength lambdaa=193.7590nm arsenic As with larger wavelength than the **** detection light L0 is used as a criteria light If it is the criteria light to which wavelength is close to the detected light L0, the size of wavelength to the class (class of element) of criteria light and the detected light L0 and the number of criteria light will not be asked.
[0094] As shown in drawing 5 , the luminescence line Ln (detection channel number Sn of a sensor 10) of the neon Ne which is wavelength lambdan=193.00345nm with wavelength respectively smaller than the detected light L0, and the luminescence line Lc (detection channel number Sc of a sensor 10 (>Sn)) of wavelength lambdac=193.0905nm carbon C may be used as a criteria light.
[0095] Moreover, as shown in drawing 6 , the luminescence line Ln (detection channel number Sn of a sensor 10) of the neon Ne which is wavelength lambdan=193.00345nm with wavelength smaller than the detected light L0, and the luminescence line Lg (detection channel number Sg of a sensor 10) of the germanium germanium which is wavelength lambdag=193.4048nm with larger wavelength than the detected light L0 may be used as a criteria light.
[0096] Moreover, as shown in drawing 7 , the luminescence line Lg (detection channel number Sg of a sensor 10) of the germanium germanium which is wavelength lambdag=193.4048nm with respectively larger wavelength than the detected light L0, and the luminescence line La (channel number Sa (> Sg) of a sensor 10) of wavelength lambdaa=193.7590nm arsenic As may be used as a criteria light.
[0097] Moreover, the luminescence line Ln (detection channel number Sn of a sensor 10) of the neon Ne which is wavelength lambdan=193.00345nm with wavelength smaller than the detected light L0 as shown in drawing 8 , The luminescence line Lg (detection channel number Sg of a sensor 10) of the germanium germanium which is wavelength lambdag=193.4048nm with respectively larger wavelength than the detected light L0, Three criteria light with the luminescence line La (channel number Sa of a sensor 10) of wavelength lambdaa=193.7590nm arsenic As may be used.
[0098] Moreover, these arsenic As, Neon Ne, Germanium germanium, and Carbon C can be constructed suitably, and it can also be used as a ****** criteria light.
[0099] This can be used if there is a carbon lamp which makes Carbon C emit light as a criteria light. For example, in the case of the combination of the neon Ne shown in drawing 5 , and Carbon C, the carbon (C) lamp which makes Neon Ne a buffer gas can be used as the criteria light source 2.
[0100] Moreover, in the case of the combination of the neon Ne shown in drawing 6 , and Germanium germanium, the germanium (germanium) lamp which makes Neon Ne a buffer gas can be used as the criteria light source 2.
[0101] Moreover, in the case of the combination of the arsenic As shown in drawing 7 , and Germanium germanium, the hollow cathode lamp with which Arsenic As and Germanium germanium were mixed can be used as the criteria light source 2.
[0102] Moreover, as shown in drawing 8 , in the case of the combination of Neon Ne, Germanium germanium, and Arsenic As, the lamp containing each element which emits light near these 193nm can be used as the criteria light source.
[0103] drawing 8 -- being shown -- as -- three -- a ** -- an element -- criteria -- light -- having used it -- a case -- **** -- two -- a ** -- an element -- sequential -- selection -- carrying out -- having mentioned above -- (-- one --) -- a formula -- from -- a spectroscope -- seven -- a variance -- D -- asking --

supposing -- three -- a ** -- a variance -- D -- one -- D -- two -- D -- three -- obtaining -- having . In this case, what is necessary is just to determine the average of these three variances D1, D2, and D3 as the variance D of the final spectroscope 7.
[0104] As shown in drawing 2 , when the wavelength lambda 0 of the detected light L0 exists between wavelength lambdan of two criteria light Ln and La, and lambdaa, the advantage that it can ask for the wavelength lambda 0 of the detected light L0 with a sufficient precision with interpolation is acquired. This is because the relation between each sensor location of a line sensor 10 and wavelength is not completely linearity. In addition, since it is extrapolated when the wavelength lambda 0 of the detected light L0 exists out of between wavelength lambdan of two criteria light Ln and Lc, and lambda c, as shown in drawing 5 , the detection precision of the wavelength lambda 0 of the detected light L0 will be a little inferior.
[0105] Moreover, although the arsenic lamp with which neon gas was enclosed as a buffer gas is used as the criteria light source 2 and it is made to carry out the radiant power output of two kinds of criteria light from the one criteria light source 2 with the operation gestalt mentioned above, the operation to which the radiant power output of the criteria light is carried out from the separate criteria light source is also possible.
[0106] Drawing 9 shows the example of a configuration which used the two criteria light sources 11 and 12.
[0107] As shown in this drawing 9 , the arsenic lamp 11 which carries out the radiant power output of the luminescence line La of wavelength lambdaa=193.7590nm arsenic As, and the neon glow lamp 12 which carries out the radiant power output of the luminescence line Ln of wavelength lambdan=193.00345nm neon Ne are prepared as the criteria light sources 11 and 12, and incidence of the light by which the radiant power output was carried out from each criteria light sources 11 and 12 is carried out to an integrating sphere 13. Similarly, the radiant power output of the wavelength lambda0=193.3nm detected light L0 is carried out from the detected light source 1, and incidence is carried out to an integrating sphere 13 through a lens 3. Incidence to the integrating sphere 13 of the light L0 detected [these] and the criteria light La and Ln is performed to coincidence.
[0108] In an integrating sphere 13, scattered reflection of the light by which incidence was carried out is carried out, and they is scattered about uniformly. Therefore, it mixes uniformly within an integrating sphere 13, and incidence of two criteria light La and Ln and detected light L0 is carried out to a spectroscope 7 through a lens 14 from the one light source. Since it is the same as that of the operation gestalt mentioned above about the processing after incidence was carried out to light into the spectroscope 7, the explanation is omitted.
[0109] As for two criteria light La and Ln mentioned above and detected light L0, it is desirable to carry out incidence to coincidence. It is because the property of the spectroscope 7 changed according to an environment can be measured on real time.
[0110] The wavelength detection equipment which used the FAPURIPERO etalon spectroscope next is explained with reference to drawing 10 and drawing 11 .
[0111] As shown in drawing 10 , with this wavelength detection equipment, through a lens 3, it is reflected in part by the beam splitter 5, and the oscillation laser beam L0 which is a detected light outputted from the detected light source 1 is irradiated by the diffusion plate 15. From the diffusion plate 15, it is scattered about, and outgoing radiation of the detected light L0 is carried out, and it is irradiated by the etalon 16. The criteria light Ln (luminescence line of Neon Ne) and La (luminescence line of Arsenic As) outputted from the criteria light source 2 on the other hand is irradiated through a lens 4 by the back etalon 16 which the part was penetrated by the beam splitter 5 and diffused with the diffusion plate 15. The etalon 16 consists of two transparence plates with which the inside field was used as the partial reflection mirror here. An etalon 16 makes the criteria light Ln and La and the detected light L0 from which wavelength differs penetrate.
[0112] Incidence of the light which penetrated the etalon 16 is carried out to a condenser lens 17. This condenser lens 17 is an achromatic lens with which for example, chromatic-aberration amendment was performed, and chromatic aberration is amended by passing through an achromatic condenser 17.

[0113] The line sensor 18 is arranged on the focus of a condenser lens 17. Image formation of the light which passed through the condenser lens 17 by this is carried out on a line sensor 18, and it forms interference fringe 19b corresponding to interference fringe 19a corresponding to wavelength lambdaa of the criteria light La (arsenic As), and wavelength lambdan of the criteria light Ln (neon Ne), and interference fringe 19c corresponding to the wavelength lambda 0 of the detected light L0 on the detection side on this line sensor 18. These interference fringes are formed in concentric circular on a line sensor 18.
[0114] The radius from the center position of the line sensor 18 of interference fringe 19a corresponding to Arsenic As is Ra, this radius of interference fringe 19b corresponding to Neon Ne is Rn, and this radius of interference fringe 10c corresponding to the detected light L0 is R0.
[0115] In a line sensor 18, the radii Ra, Rn, and R0 from a line sensor core to each interference fringe image formation location are detected.
[0116] As shown in drawing 11 here, the square R2 of the radius R from a line sensor core to an interference fringe image formation location and the relation of the wavelength lambda of light by which image formation was carried out to the line sensor 18 are theoretically approximated to linearity relation.

[0117] That is, the relation between the squares Rn2 and Ra2 of the radius of the interference fringes 19b and 19a of the criteria light Ln and La, and wavelength lambdan and lambdaa is expressed with a linearity function, and can ask for the multiplier. Specifically, the inclination of a straight line Q becomes settled.
[0118] Therefore, square R02 of a straight line Q to the radius which can ask for the square R02 of a radius by this, and is shown in drawing 11 since the image formation location R0 of interference fringe 19c of the detected light L0, i.e., the radius of interference fringe 19c, is now detected by the line sensor 18 It can ask for the corresponding wavelength lambda 0 as wavelength of the detected light L0.
[0119] In addition, although the explanation mentioned above explained the case where the oscillation laser beam of argon fluorine (ArF) excimer laser was made into a detected light, when making the oscillation laser beam of krypton fluorine (KrF) excimer laser into the detected light L0, the wavelength lambda 0 of the detected light L0 can be similarly detected using the criteria light source which outputs the luminescence line of the wavelength close to wavelength lambda0=248.4nm. For example, the iron (Fe) lamp which outputs the luminescence line of level by which iron (Fe) differs as the criteria light source 2 can be used. From an iron (Fe) lamp, the wavelength of 248.2371nm and two 248.4188nm luminescence lines are outputted.
[0120] In addition, instead of the spectroscope 7 of the diffraction-grating mold shown in drawing 1 , spectroscope 7" of the diffraction-grating mold shown in drawing 12 may be used.
[0121] By the way, although he is trying to use the luminescence line of Neon Ne, Arsenic As, Carbon C, and Germanium germanium as a criteria light, you may make it use the luminescence line of Platinum Pt as a criteria light with the operation gestalt mentioned above.
[0122] In addition, a hollow cathode lamp can be used as the light source which outputs the luminescence line of Platinum Pt.
[0123] As shown in drawing 13 , Platinum Pt has the luminescence lines LP1, LP2, and LP3 which are three from which wavelength differs.
[0124] The wavelength of each three luminescence lines LP1, LP2, and LP3 outputted from a platinum lamp is lambdaP1=193.4369nm (channel number SP1 of a sensor 10), lambdaP2=193.2243nm (channel number SP2 of a sensor 10), and lambdaP3=193.7245nm (channel number SP3 of a sensor 10), and is approximated to wavelength lambda0=193.3nm of an argon fluorine excimer laser luminescence line.
[0125] For this reason, it is possible to use only one luminescence line as a criteria light among each three luminescence lines LP1, LP2, and LP3.
[0126] However, if two or more luminescence lines are used as a criteria light among each three luminescence lines LP1, LP2, and LP3, the variance D of a spectroscope 7 can be calculated like the operation gestalt mentioned above, and the wavelength lambda 0 of the detected light L0 outputted still further from the detected light source 1 can be detected with a without error and sufficient precision.

[0127] Now, although he is trying to use a luminescence line as a criteria light for detecting the wavelength of argon fluorine excimer laser with the operation gestalt explained above, the wavelength of argon fluorine excimer laser may be detected using the absorption line.
[0128] Drawing 14 and 15 are drawings showing the operation gestalt of the wavelength detection equipment which detects the wavelength of argon fluorine excimer laser using the absorption line. However, drawing 15 is drawing showing an operation gestalt when the spectral line width of the absorption line is narrower than the spectral line width of argon fluorine excimer laser.
[0129] From the detected light source 1 which is argon fluorine excimer laser equipment, the oscillation laser beam L0 of predetermined power is injected as a detected light L0 through the front mirror 21.
[0130] On the other hand, the steamy gas of the platinum Pt which has the absorption lines (wavelength lambdaP1=193.4369nm, lambdaP2=193.2243nm, and lambdaP3=193.7245nm) BP1, BP2, and BP3 is enclosed with the absorption cell 23 as the absorption line to the luminescence line of argon fluorine excimer laser.
[0131] Here, the wavelength lambdaP1 of the absorption lines BP1, BP2, and BP3 of platinum Pt gas, lambdaP2, and lambdaP3 are the same as that of the value of the wavelength of the luminescence lines LP1, LP2, and LP3 shown in drawing 13 at drawing 13 , and are approximated to wavelength lambda0=193.3nm of the luminescence line L0 of argon fluorine excimer laser.
[0132] For this reason, the absolute wavelength of the oscillation laser beam L0 is detectable by adjusting the wavelength lambda 0 of the narrow-band-ized oscillation laser beam L0 to the wavelength of the one or more absorption lines among the wavelength lambdaP1 of the above-mentioned absorption lines BP1, BP2, and BP3, lambdaP2, and lambdaP3.
[0133] In addition, the wavelength of the absorption line of Neon Ne, Arsenic As, Carbon C, and Germanium germanium is also approximated to wavelength lambda0=193.3nm of the luminescence line L0 of argon fluorine excimer laser besides absorption-lines [of Platinum Pt] BP1 and BP2, and BP3.
[0134] The wavelength of the absorption line of these neon Ne, Arsenic As, Carbon C, and Germanium germanium is the same as that of the value of the wavelength of the luminescence line which is shown in drawing 2 , drawing 5 , drawing 6 , drawing 7 R> 7, and drawing 8 and which was mentioned above.
[0135] For this reason, the absolute wavelength of the oscillation laser beam L0 is also detectable by adjusting the wavelength lambda 0 of the narrow-band-ized oscillation laser beam L0 to the wavelength of the one or more absorption lines among wavelength lambdaa of the absorption lines Ba, Bn, Bc, and Bg of the above-mentioned arsenic As, Neon Ne, Carbon C, and Germanium germanium, lambdan, lambdac, and lambdag.
[0136] Incidence of the detected light L0 is carried out to beam splitter 5a in the monitor module 22. It is reflected by beam splitter 5a, and incidence of a part of detected light L0 is carried out to beam splitter 5b. A part of detected light L0 penetrates beam splitter 5b, and incidence is carried out to an absorption cell 23. Moreover, after the remaining detected light L0 reflected by beam splitter 5b is irradiated by diffusion plate 15b, it is scattered about and the optical reinforcement is detected by the photodiode 24. And the detected light L0 which passed the absorption cell 23 is irradiated by diffusion plate 15a. From diffusion plate 15a, it is scattered about, and outgoing radiation of the detected light L0 is carried out, and incidence is carried out into a spectroscope 7. And as mentioned above, according to the channel number which detected the light of the maximum reinforcement by two or more light-receiving channels on the sensor 10, the detection location of the detected light L0 on a line sensor becomes settled, and the wavelength lambda 0 of the detected light L0 becomes settled from the channel number which detected the detected light L0.
[0137] By having made the absorption cell 23 (platinum Pt gas being enclosed) penetrate the detected light L0 of the argon fluorine excimer laser of spontaneous emission, drawing 15 shows signs that optical reinforcement of the luminescence line of the detected light L0 is made into the minimum by the absorption lines BP1, BP2, and BP3 of spectral line width narrower than the spectral line width of the luminescence line L0.
[0138] In addition, when enclosing platinum Pt gas, a through type hollow cathode lamp may be used.
[0139] The sensor 10 is equipped with two or more light-receiving channels, and the photodetection

location on a sensor 10 becomes settled according to the channel number which detected the light of the maximum reinforcement. By the sensor 10, since the incidence locations to a sensor 10 differ according to wavelength, the wavelength of light is detectable from the photodetection location of a sensor 10. Therefore, the wavelength of light becomes settled from the channel number which detected light.
[0140] Platinum Pt gas shall be now enclosed with the absorption cell 23. In this case, after the detected light L0 passes platinum Pt gas, incidence is carried out to a spectroscope 7 through diffusion plate 15a, and the optical reinforcement of that spectrum is detected by channel number SP on a sensor 10.
[0141] In this case, the spectral line width W1 and W2 narrower than the luminescence line breadth W0 of the detected light L0 and the absorption lines BP1, BP2, and BP3 of W3 are contained in the luminescence line breadth W0 of the detected light L0. That is, in the wavelength lambda luminescence line breadth W0 of the detected light L0 which has 0= 193.3nm, wavelength lambdaP1=193.4369nm of Platinum Pt, lambdaP2=193.2243nm, and lambdaP3=193.7245nm are contained respectively. Therefore, optical reinforcement of the part equivalent to wavelength lambdaP1=193.4369nm in the luminescence line of the detected light L0, lambdaP2=193.2243nm, and lambdaP3=193.7245nm is made into the minimum by the absorption lines BP1, BP2, and BP3.
[0142] Moreover, gas, such as Arsenic As, Neon Ne, Carbon C, or Germanium germanium, shall be enclosed with the absorption cell 23, for example.
[0143] In this case, the absorption lines Ba, Bn, Bc, and Bg of spectral line width narrower than the luminescence line breadth W0 of the detected light L0 are also contained in the luminescence line breadth W0 of the detected light L0. That is, in the wavelength lambda luminescence line breadth W0 of the detected light L0 which has 0= 193.3nm, wavelength lambdaa=193.7590nm of Arsenic As, wavelength lambdan=193.00345nm of Neon Ne, wavelength lambdac=193.0905nm of Carbon C, and wavelength lambdag=193.4048nm of Germanium germanium are contained respectively. Therefore, optical reinforcement of the part equivalent to wavelength lambdaa=193.7590nm in the luminescence line of the detected light L0, lambdan=193.00345nm, lambdac=193.0905nm, and lambdag=193.4048nm is made into the minimum by the absorption lines Ba, Bn, Bc, and Bg.
[0144] Drawing 16 is drawing showing an operation gestalt when the spectral line width of the absorption line is wider than the spectral line width of argon fluorine excimer laser.
[0145] Also in this case, the oscillation laser beam L0 of predetermined power is injected as a detected light L0 through the front mirror 21 from the detected light source 1 which is argon fluorine excimer laser equipment.
[0146] And incidence of the detected light L0 is carried out to beam splitter 5a in the monitor module 22. It is reflected by beam splitter 5a, and incidence of a part of detected light L0 is carried out to beam splitter 5b. A part of detected light L0 penetrates beam splitter 5b, and incidence is carried out to beam splitter 5c. Moreover, after the remaining detected light L0 reflected by beam splitter 5b is irradiated by diffusion plate 15b, it is scattered about and the optical reinforcement is detected by the photodiode 24. It is reflected by beam splitter 5c, and incidence of a part of detected light L0 is carried out to an absorption cell 23. And the detected light L0 penetrates an absorption cell 23, and the optical reinforcement is detected by the light-intensity detector 25.
[0147] On the other hand, a part of detected light L0 which penetrated beam splitter 5c is irradiated by diffusion plate 15a. From diffusion plate 15a, it is scattered about, and outgoing radiation of the detected light L0 is carried out, and incidence is carried out into a spectroscope 7. And the wavelength lambda 0 of the detected light L0 becomes settled from the channel number which detected the optical reinforcement of the detected light L0 on the sensor 10 as mentioned above.
[0148] By having made the absorption cell 23 (platinum Pt gas being enclosed) penetrate the detected light L0 of argon fluorine excimer laser, drawing 17 shows signs that optical reinforcement of the luminescence line of the detected light L0 is made the minimum by the absorption line BP1 of spectral line width larger than the spectral line width of the luminescence line L0, or BP2 or BP3.
[0149] A light-intensity detector 25 should just detect optical reinforcement. For example, they are a photodiode, a photomultiplier, etc.
[0150] Platinum Pt gas shall be now enclosed with the absorption cell 23. And after the optical

reinforcement of the detected light L0 passes platinum Pt gas, the optical reinforcement is detected by the light-receiving channel on a light-intensity detector 25.
[0151] At this time, the luminescence line of the detected light L0 is made into the optical minimum reinforcement H2 from the optical reinforcement H1 by the absorption line of the spectral line width W1 or W2 larger than the luminescence line breadth W0 of the detected light L0, or W3.
[0152] Moreover, gas, such as Arsenic As, Neon Ne, Carbon C, or Germanium germanium, shall be enclosed with the absorption cell 23, for example. At this time, after the optical reinforcement of the detected light L0 passes arsenic As gas, neon Ne gas, carbon C gas, or germanium germanium gas, that optical reinforcement is detected by the light-receiving channel on a light-intensity detector 25. And the luminescence line of the detected light L0 is made into the optical minimum reinforcement H2 from the optical reinforcement H1 by the absorption lines, such as the arsenic As of spectral line width larger than the luminescence line breadth W0 of the detected light L0, Neon Ne, Carbon C, or Germanium germanium.
[0153] Next, processing of wavelength detection of the oscillation laser beam L0 using the three absorption lines BP1, BP2, and BP3 of the platinum Pt of spectral line width narrower than the luminescence line breadth of argon fluorine excimer laser is explained with reference to drawing 14 , drawing 18 , and drawing 19 by making into an example the case where platinum Pt gas is enclosed in an absorption cell 23.
[0154] Drawing 18 (a) is the flow chart of wavelength control of the oscillation laser beam L0 which used the absorption line, and this drawing (b) is drawing showing the relation between the oscillation wavelength lambda 0 and optical reinforcement.
[0155] In the flow chart of drawing 18 (a), the wavelength calibration subroutine which the controller 20 first shown in drawing 21 fixes to the wavelength aiming at the main wavelength lambda 0 of the spectrum of the oscillation laser beam L0 based on the command signal from the outside is performed (step 200).
[0156] If a wavelength calibration subroutine is performed, the oscillation wavelength lambda 0 of the oscillation laser beam L0 will emit light by predetermined preliminary-waves length (step 201).
[0157] Next, the absorption cell 23 by which platinum Pt gas is enclosed in the monitor module 22 shown in drawing 14 is penetrated, and the optical reinforcement of the oscillation laser beam L0 which passed diffusion plate 15a and a spectroscope 7 is called for on a sensor 10. According to the channel number which detected the light of the maximum reinforcement at this time, the photodetection location on a sensor 10 becomes settled. However, the channel number on the sensor 10 which detects the optical reinforcement of the spectrum of an oscillation laser beam changes according to change of the oscillation wavelength lambda 0 (step 202).
[0158] Next, only an amount predetermined in the oscillation wavelength lambda 0 of the oscillation laser beam L0 from preliminary-waves length changes with controllers 20. The minimum points Z2, Z1, and Z3 that the optical reinforcement of the spectrum of the oscillation laser beam L0 becomes the minimum by this are looked for one by one (step 203).
[0159] And it is judged whether the oscillation wavelength lambda 0 turned into proofreading termination wavelength (step 204).
[0160] the case where it is judged with the oscillation wavelength lambda 0 of the oscillation laser beam L0 not being proofreading termination wavelength -- (the decision N0 of step 204) -- it shifts to step 202 and step 203 again, and only an amount further predetermined in the oscillation wavelength lambda 0 of the oscillation laser beam L0 changes. On the other hand, when the oscillation wavelength lambda 0 of the oscillation laser beam L0 turns into proofreading termination wavelength, as shown in (the decision YES of step 204) and drawing 18 (b), the data d of the relation between the oscillation wavelength lambda 0 and optical reinforcement are plotted (step 205).
[0161] And optical reinforcement of the spectrum of the oscillation laser beam L0 detected on the sensor 10 as shown in the points Z1, Z2, and Z3 of the data d of drawing 18 (b) is made into the minimum by the absorption lines BP1, BP2, and BP3. Since the wavelength of the minimum points Z1, Z2, and Z3 is wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3,

lambdaP2=193.2243nm, and lambdaP3=193.7245nm The main wavelength lambda 0 of the spectrum of the oscillation laser beam L0 by which incidence is carried out to the light-receiving channels Sz1, Sz2, and Sz3 on the sensor 10 corresponding to the location of the minimum points Z1, Z2, and Z3 Wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm, It is proofread by lambdaP3=193.7245nm. Thereby, the light-receiving channels Sz1, Sz2, and Sz3 on the sensor 10 corresponding to the location of the minimum points Z1, Z2, and Z3 become clear. Moreover, the wavelength difference between the light-receiving channels on a sensor 10 can be decided by the distance of a spectroscope 7 and a sensor 10, and the property of a lens, and can be expressed with a constant delta. Therefore, the wavelength lambda 0 of the strange oscillation laser beam L0 by which optical reinforcement is detected on a sensor 10 Wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm, and lambdaP3=193.7245nm, X1, X2, and X3 channels between the light-receiving channels Sz1, Sz2, and Sz3 and the light-receiving channel SP by which the wavelength lambda 0 of the strange oscillation laser beam L0 is detected, a constant delta -- using -- (12), (following 13), and following (14) type and
lambda01=193.4369**X1xdelta -- (12)
lambda02=193.2243**X2xdelta -- (13)
lambda03=193.7245**X3xdelta -- (14)
It can ask depending on whether it is ********. Moreover, the average of three wavelength lambda01, lambda02, and lambda02 for which it asked respectively from each above-mentioned formula can be calculated as wavelength lambda 0 of the final strange oscillation laser beam L0. Furthermore, since the two or more absorption lines are used, the variance D of a spectroscope 7 can be calculated like the operation gestalt using two or more criteria light mentioned above (step 206).
[0162] Next, processing of wavelength detection of the oscillation laser beam L0 using the absorption lines BP1, BP2, and BP3 of the platinum Pt of spectral line width larger than the luminescence line breadth of argon fluorine excimer laser is explained with reference to drawing 16 , drawing 18 , and drawing 19 .
[0163] Processing to steps 200-201 shown in drawing 18 (a) first mentioned above is performed.
[0164] Next, the optical reinforcement of the spectrum of the oscillation laser beam L0 which penetrated the absorption cell 23 by which platinum Pt gas is enclosed in the monitor module 22 shown in drawing 16 is detected on a light-intensity detector 25 (step 202).
[0165] Next, only an amount predetermined in the oscillation wavelength lambda 0 of the oscillation laser beam L0 from preliminary-waves length changes with the controllers 20 shown in drawing 19 . The minimum point that the optical reinforcement of the spectrum of the oscillation laser beam L0 detected on a light-intensity detector 25 by this becomes the minimum is looked for (step 203).
[0166] Next, processing to steps 204-205 shown in drawing 18 (a) mentioned above is performed.
[0167] Consequently, the oscillation wavelength lambda 0 of the oscillation laser beam L0 by which incidence is carried out to the light-receiving channels Sz1, Sz2, and Sz3 on a sensor 10 when optical reinforcement of the spectrum of the oscillation laser beam L0 detected on a light-intensity detector 25 at step 203 is made into the minimum by the absorption lines BP1, BP2, and BP3 is set to the wavelength lambdaP1 of the absorption lines BP1, BP2, and BP3, lambdaP2, and lambdaP3. Therefore, the wavelength lambda 0 of the strange oscillation laser beam L0 by which optical reinforcement is detected on a sensor 10 Wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm and lambdaP3=193.7245nm X1, X2, and X3 channels between the light-receiving channels Sz1, Sz2, and Sz3 and the light-receiving channel SP by which the wavelength lambda 0 of the strange oscillation laser beam L0 is detected, and the above-mentioned constant delta are used. Above (12), It can ask similarly from (13) and (14) types as wavelength lambda 0 of the final strange oscillation laser beam L0 (step 206).
[0168] In addition, in case it asks for the wavelength lambda 0 of the strange oscillation laser beam L0, the one absorption line or the two absorption lines may be used among the three absorption lines BP1, BP2, and BP3 of Platinum Pt.
[0169] However, if two or more of the three absorption lines BP1, BP2, and BP3 are used like the

operation gestalt mentioned above, the variance D of a spectroscope 7 can be calculated, and the wavelength lambda 0 of the detected light L0 outputted still further from the detected light source 1 can be detected with a without error and sufficient precision.

[0170] As explained above, in argon fluorine excimer laser, the one or more absorption lines are used as the absorption line as the absorption line to said argon fluorine excimer laser luminescence line among the absorption lines of Platinum Pt, Arsenic As, Neon Ne, Carbon C, and Germanium germanium to detect wavelength lambda0=193.3nm of the oscillation laser beam L0.

[0171] Even if individual difference is in a spectroscope 7 by this, or a measurement environment carries out fluctuation etc. and the property of a spectroscope 7 changes, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to suitable wavelength detection equipment to detect the wavelength of the oscillation laser beam of argon fluorine (ArF) excimer laser and krypton fluorine (KrF) excimer laser especially about the wavelength detection equipment which detects the wavelength of light, such as laser.

[Translation done.]

PRIOR ART

[Description of the Prior Art] To use excimer laser as the light source of a stepper (contraction projection aligner), it is necessary to narrow-band-ize the oscillation laser beam of excimer laser. It is necessary to carry out stabilization control with high precision so that it furthermore may not shift while exposing the main wavelength of the spectrum of this narrow-band-ized oscillation laser beam.
[0003] Drawing 19 is the wavelength stabilization control unit of common laser.
[0004] Narrow-band-ization is performed by driving narrow-band-ized components arranged in the narrow-band-ized module 26, such as an etalon and a grating, through a driver 28 by the controller 20 (an etalon or the installation include angle of a grating being adjusted). During exposure, control of wavelength is made so that the main wavelength of a spectrum may not be changed.
[0005] That is, the absolute wavelength of the oscillation laser beam L0 is detected [in the monitor module 22] by always detecting the relative wavelength of the oscillation laser beam L0 to criteria light during exposure.
[0006] Next, a narrow-band-ized component drives through a driver 28 by feeding back this detection result to a controller 20.
[0007] And the main wavelength of the spectrum of the laser beam L0 which emits light through the laser chamber 27 is fixed to target wavelength.
[0008] In JP,4-163980,A, the luminescence line of arsenic (As) with a wavelength of 193.696nm is used as a criteria light for [of the oscillation laser beam of argon fluorine excimer laser (wavelength of about 193.3nm)] detecting wavelength absolutely.
[0009] Namely, incidence is carried out to a spectroscope by making into criteria light the luminescence line which emits light from an arsenic enclosure discharge lamp. Incidence is carried out to this spectroscope by making into a detected light the oscillation laser beam of the argon fluorine excimer laser which wants to detect wavelength to coincidence. And in a spectroscope, the spectrum of criteria light and the detected light is carried out, and image formation of the image of the light which carried out the spectrum is carried out on a line sensor. The detection location on a line sensor corresponds to detection wavelength.
[0010] And using a variance, from the difference of the detection location on a line sensor, it asks for the relative wavelength of a detected light to criteria light, and the absolute wavelength of a detected light is calculated based on this relative wavelength for which it asked, and the wavelength of a known criteria light.
[0011] A variance is explained here. Drawing 12 shows the sensor channel number (location on a line sensor) of a line sensor, and the relation of sensor signal strength. The line sensor is equipped with two or more light-receiving channels, and the photodetection location on a line sensor becomes settled according to the channel number which detected the light of the maximum reinforcement. In a line sensor, since the incidence locations to a line sensor differ according to wavelength, the wavelength of light is detectable from the photodetection location of a line sensor. Therefore, the wavelength of light becomes settled from the channel number which detected light.
[0012] A variance is the wavelength (unit nm) equivalent to channel spacing (unit mum) of a line sensor.

If a variance (wavelength equivalent to channel spacing of a line sensor) can be defined, it can ask for the relative wavelength of the detected light L0 to the criteria light La from the difference of the channel number Sa which detected the criteria light La using this variance, and the channel number S0 which detected the detected light L0.

[0013] It becomes settled with the property of a spectroscope of channel spacing being equivalent to what wavelength, or (variance) drawing light on a sensor. The property of a spectroscope becomes settled with the characteristic value of the various optical element components which constitute spectroscopes, such as the number of the slots on the grating, a focal distance of a concave mirror, and a rate of optical refraction in air.

[0014] The variance was calculating the wavelength lambda 0 of a detected light as a known value here noting that the property of a spectroscope was known conventionally that is,.

[0015] Specifically based on design values, such as a focal distance of the concave mirror inside a spectroscope, the theoretical variance (on a spectroscope design) Dt (wavelength per sensor) is calculated for every spectroscope.

[0016] And this calculated theoretical variance Dt is fixed, and he asks for the relative wavelength of the detected light L0 to the criteria light La from the difference of the detection channel number Sa of the criteria light La, and the detection channel number S0 of the detected light L0, and was trying to calculate the wavelength lambda 0 of the detected light L0 from known wavelength lambdaa (193.696nm) of this relative wavelength for which it asked, and the criteria light La.

[Translation done.]

EFFECT OF THE INVENTION

[Means for Solving the Problem and its Function and Effect] Then, a detected light which emits light according to the detected light source in the 1st invention of this invention while inputting into a spectroscope the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem is inputted into said spectroscope. The detection location of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the characteristic value of said spectroscope, and the known wavelength of said criteria light The detection location of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, The detection location of said criteria [based on the known wavelength of said two or more criteria light, calculate the actual characteristic value of said spectroscope, and] light on said sensor, and said detected light, He is trying to calculate the wavelength of said detected light based on the actual characteristic value of said said calculated spectroscope, and the known wavelength of said criteria light.

[0022] Moreover, a detected light which emits light according to the detected light source in the 2nd invention while inputting into a spectroscope the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem is inputted into said spectroscope. The detection location of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the variance of said spectroscope, and the known wavelength of said criteria light The detection location of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, The detection location of said criteria [based on the known wavelength of said two or more criteria light, calculate the actual variance of said spectroscope, and] light on said sensor, and said detected light, He is trying to calculate the wavelength of said detected light based on the actual variance of said said calculated spectroscope, and the known wavelength of said criteria light.

[0023] Moreover, a detected light which emits light according to the detected light source in the 3rd invention while inputting into a spectroscope the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem is inputted into said spectroscope. The detection location of the interference fringe of said criteria [draw criteria light and a detected light on a sensor, and] light on the sensor concerned, and said detected light, In the wavelength detection equipment which calculated the wavelength of said detected light based on the known wavelength of said criteria light The detection location of the interference fringe of two or more [make two or more criteria light from which wavelength differs as said criteria light by said criteria light source emit light, and / of an on / said sensor / said] criteria light, It is based on the known wavelength of said two or more criteria light, and the correspondence relation between the location of the interference fringe on said sensor and the wavelength of the light led to said sensor is calculated. He is trying to

calculate the wavelength of said detected light by asking for the wavelength of the light corresponding to the detection location of the interference fringe of said detected light on said sensor from said calculated correspondence relation.

[0024] Moreover, in the 4th invention, in the 1st invention of the above, the 2nd invention, and the 3rd invention, a detected light which emits light by said detected light source is an oscillation laser beam outputted from argon fluorine excimer laser, and two or more criteria light from which the wavelength which emits light by said criteria light source differs supposes that they are the luminescence line of Arsenic As, and the luminescence line of Neon Ne.

[0025] Moreover, in the 5th invention, said criteria light source supposes that it is the arsenic lamp which used Neon Ne as a buffer gas in the 4th invention of the above.

[0026] The 1st invention of the above is made to correspond to drawing 1 and drawing 2 , and is explained.

[0027] That is, according to the 1st invention, two or more criteria light Ln and La from which wavelength lambdan and lambdaa differ as a criteria light by the criteria light source 2 emits light.

[0028] And based on the detection locations Sn and Sa of two or more criteria light Ln and La on a sensor 10, and known wavelength lambdan of two or more criteria light Ln and La and lambdaa, the actual characteristic value D of a spectroscope 7 calculates (D=(lambdaa-lambdan)/(Sa-Sn)).

[0029] And based on the detection locations Sn and S0 of the criteria light Ln on a sensor 10, and the detected light L0, and the actual characteristic value D of a spectroscope 7 and known wavelength lambdan of the criteria light Ln by which the operation was carried out [above-mentioned], the wavelength lambda 0 of the detected light L0 calculates (lambda0=lambdan+ (S0-Sn) and D).

[0030] "The actual characteristic value of a spectroscope" of the 1st invention is a concept including characteristic values other than Variance D. It is a concept including characteristic values, such as the focal distance f of the concave mirror M2 inside a spectroscope, and the slot number consistency N of a grating 8, (refer to (3) types of an operation gestalt - (11) types).

[0031] Moreover, according to the 2nd invention, two or more criteria light Ln and La from which wavelength lambdan and lambdaa differ as a criteria light by the criteria light source 2 emits light.

[0032] And the actual variance D of a spectroscope 7 calculates based on the detection locations Sn and Sa of two or more criteria light Ln and La on a sensor 10, and known wavelength lambdan of two or more criteria light Ln and La and lambdaa (D=(lambdaa-lambdan)/(Sa-Sn)).

[0033] And based on the detection locations Sn and S0 of the criteria light Ln on a sensor 10, and the detected light L0, and the actual variance D of a spectroscope 7 and known wavelength lambdan of the criteria light Ln by which the operation was carried out [above-mentioned], the wavelength lambda 0 of the detected light L0 calculates (lambda0=lambdan+ (S0-Sn) and D).

[0034] Since the actual characteristic value (variance D) of a spectroscope 7 is calculated and the wavelength lambda 0 of the detected light L0 is calculated based on this actual characteristic value (variance D) according to the 1st invention and the 2nd invention as mentioned above Even if individual difference is in a spectroscope 7, or a measurement environment carries out fluctuation etc. to it and the property of a spectroscope 7 changes to it, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.

[0035] The 3rd invention is made to correspond to drawing 10 and drawing 11 , and is explained.

[0036] That is, according to the 3rd invention, two or more criteria light Ln and La from which wavelength lambdan and lambdaa differ as a criteria light by the criteria light source 2 emits light.

[0037] And it is based on the detection locations Rn and Ra of the interference fringes 19b and 19a of two or more criteria light Ln and La on a sensor 18, and known wavelength lambdan of two or more criteria light Ln and La and lambdaa, and the correspondence relation Q with the wavelength lambda of the light led to the location R2 and sensor 18 of an interference fringe on a sensor 18 calculates (refer to drawing 11).

[0038] And the wavelength lambda 0 of the detected light L0 calculates by asking for the wavelength lambda 0 of the light corresponding to the detection location R0 of interference fringe 19c of the detected light L0 on a sensor 18 from the correspondence relation Q by which the operation was carried

out [above-mentioned].
[0039] Also in **** 3 invention, since the actual correspondence relation Q with the wavelength lambda of the light led to the location R2 and sensor 18 of an interference fringe on a sensor 18 is correctly called for even if individual difference is in a spectroscope, or it changes a measurement environment to it and the property of a spectroscope changes to it, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0040] Moreover, according to the 4th invention, as shown in drawing 2 , the luminescence line Ln of wavelength lambdan=193.00345nm [with wavelength smaller than the wavelength lambda0=193.3nm detected light (oscillation laser beam of argon fluorine excimer laser) L0] neon Ne and the luminescence line La of wavelength lambdaa=193.7590nm arsenic As with larger wavelength than the **** detection light L0 are used as a criteria light. Thus, since the wavelength lambda 0 of the detected light L0 exists between wavelength lambdan of two criteria light Ln and La, and lambdaa, it can ask for the wavelength lambda 0 of the detected light L0 with a sufficient precision with interpolation.
[0041] Moreover, according to the 5th invention, as shown in drawing 1 , the criteria light source 2 is used as the arsenic (As) lamp which used Neon Ne as a buffer gas.
[0042] Thus, according to the 5th invention, light can be emitted in two criteria light Ln (neon) and La (arsenic) from the one criteria light source 2, and it is not necessary to prepare the two criteria light sources separately.
[0043] Moreover, it sets to the wavelength detection equipment which detects the wavelength of a detected light outputted from the detected light source in the 6th invention based on the wavelength of the criteria light which emits light according to the criteria light source in order to attain the above-mentioned solution technical problem. When said detected light is an argon fluorine excimer laser luminescence line, he has the wavelength most approximated to the wavelength of said argon fluorine excimer laser luminescence line, and is trying to use one or more luminescence lines as said criteria light among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed.
[0044] The 6th invention of the above is made to correspond to drawing 13 , and is explained.
[0045] That is, according to the 6th invention, it has the wavelength most approximated to the wavelength of an argon fluorine excimer laser luminescence line as a criteria light of the criteria light source, and one or more luminescence lines are used among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed.
[0046] Here For example, when three luminescence lines LP1, LP2, and LP3 of the platinum Pt which has the wavelength approximated most in the wavelength lambda 0 of the detected light L0 of argon fluorine excimer laser as shown in drawing 13 are used as a criteria light, Based on the wavelength lambdaP1 of the criteria light LP1, LP2, and LP3 on a sensor 10, lambdaP2, and lambdaP3, the wavelength lambda 0 of the detected light L0 is detected.
[0047] Thus, since according to the 6th invention it has the wavelength most approximated to the wavelength of an argon fluorine excimer laser luminescence line and uses as one or more luminescence line standard light among the luminescence lines whose optical reinforcement is three of the platinum Pt more than fixed, the wavelength lambda 0 of the detected light L0 is detectable.
[0048] Even if individual difference is in a spectroscope 7 by this, or a measurement environment carries out fluctuation etc. and the property of a spectroscope 7 changes, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0049] Moreover, it sets to the wavelength detection equipment which detects the wavelength of said detected light in the 7th invention based on the absorption line which makes the minimum optical reinforcement of a detected light outputted from the detected light source in order to attain the above-mentioned solution technical problem. The platinum Pt which has the wavelength of said argon fluorine excimer laser luminescence line, and the approximated wavelength when said detected light is an argon fluorine excimer laser luminescence line, He is trying to use the one or more absorption lines as the absorption line to said argon fluorine excimer laser luminescence line among the absorption lines of Arsenic As, Neon Ne, Carbon C, and Germanium germanium.

[0050]
[Embodiment of the Invention] The wavelength detection equipment applied to this invention with reference to a drawing below is explained.
[0051] With this operation gestalt, the case where the wavelength of argon fluorine (ArF) excimer laser is detected is assumed. However, also when detecting the wavelength of krypton fluorine (KrF) excimer laser, it can apply. The wavelength of krypton fluorine excimer laser is about 248.4nm. The wavelength of argon fluorine excimer laser is about 193.3nm. Moreover, it is applicable also to detection of the wavelength of light other than a laser beam.
[0052] Drawing 1 shows the configuration of the wavelength detection equipment of an operation gestalt.
[0053] The detected light source 1 is the light source by which the detected light L0 which wants to detect wavelength is injected, and is argon fluorine excimer laser equipment with this operation gestalt. The laser beam oscillated by carrying out discharge excitation by the laser chamber of argon fluorine excimer laser equipment is amplified by carrying out both-way migration of the inside of the resonator which the front mirror 21 and the narrow-band-ized module 26 constitute, and is injected as an oscillation laser beam L0 of predetermined power from a laser ejection aperture.
[0054] On the other hand, the criteria light source 2 is an arsenic (As) lamp with which Neon Ne is enclosed as a buffer gas. In addition, the buffer gas is enclosed in the lamp so that the filament of a lamp may not burn. As for an arsenic lamp, a hollow cathode lamp is used. Therefore, from the criteria light source 2, the luminescence line Ln of neon Ne with a wavelength of 193.00345nm and the luminescence line La of arsenic As with a wavelength of 193.7590nm emit light as criteria light Ln and La which is two from which wavelength differs. Therefore, according to this operation gestalt, the advantage that light can be emitted in two criteria light Ln (neon) and La (arsenic) is acquired from the one criteria light source 2. It is not necessary to prepare the two criteria light sources separately.
[0055] Incidence of the detected light L0 is carried out to a beam splitter 5 through a lens 3. It is reflected by the beam splitter 5 and a part of detected light L0 is led to a shutter 6. Incidence of the criteria light Ln and La is carried out to a beam splitter 5 through a lens 4. A part of criteria light Ln and La penetrates a beam splitter 5, and it is led to a shutter 6.
[0056] In this way, the detected light L0 and the criteria light Ln and La pass a shutter 6, and incidence is carried out into a spectroscope 7.
[0057] If incidence of the detected light L0 and the criteria light Ln and La is carried out to a spectroscope 7, incidence will be first carried out to a concave mirror M1, and incidence will be carried out to the grating 8 whose reflected light is a diffraction grating. According to the wavelength of the light by which incidence is carried out, whenever [angle-of-diffraction / of a grating 8] changes. Incidence of the detected light L0 and the criteria light Ln and La which were diffracted by the grating 8 is carried out to a concave mirror M2, and the reflected light is led to a sensor 10 through a reflecting mirror 9.
[0058] As for a sensor 10, a line sensor is used. Specifically, it can constitute using a single dimension, 2-dimensional image sensors, or a diode array.
[0059] If the wavelength of the light by which incidence is carried out to a spectroscope 7 differs, whenever [in a grating 8 / angle-of-diffraction] differ, and the incidence locations to a sensor 10 differ. The spectrum of the detected light L0 and the criteria light Ln and La from which wavelength differs to a sensor 10 as a result is carried out, and they can detect each wavelength lambda 0 of the detected light L0 by which incidence was carried out and incidence was carried out to the spectroscope 7 according to the detection location on a sensor 10, and the criteria light Ln and La, lambdan, and lambdaa. That is, the spectrum profile on a line sensor changes with the wavelength of light. In addition, when an etalon is used instead of a grating, the fringe pattern on a line sensor changes.
[0060] A spectroscope 7 may be made to carry out incidence of the criteria light Ln and La which emitted light by the criteria light source 2, and the detected light L0 which emitted light by the detected light source 1 to coincidence, criteria light and a detected light may be shifted in time, and incidence may be carried out to a spectroscope 7.

[0061] With this operation gestalt, the case where the excimer laser equipment of the detected light source 1 is used as the light source of a stepper (contraction projection aligner) is assumed. In this case, it is necessary to narrow-band-ize the oscillation laser beam L0 of excimer laser. It is necessary to carry out stabilization control with high precision so that it furthermore may not shift while exposing the main wavelength of the spectrum of this narrow-band-ized oscillation laser beam L0.
[0062] Narrow-band-ization is performed by driving narrow-band-ized components arranged in the resonator of a laser chamber, such as an etalon and a grating, (an etalon or the installation include angle of a grating being adjusted). During exposure, control of wavelength is made so that the main wavelength of a spectrum may not be changed.
[0063] For this reason, the absolute wavelength lambda 0 of the oscillation laser beam L0 is detected during exposure by the wavelength detection equipment shown in drawing 1 by always detecting the relative wavelength of the oscillation laser beam L0 to the criteria light Ln and La. And by feeding back this detection result, a narrow-band-ized component drives and the main wavelength of the spectrum of the oscillation laser beam L0 is fixed to target wavelength.
[0064] A controller 20 performs fixed control of the wavelength which performs wavelength detection processing shown in drawing 3 mentioned later, and mentions it above based on the obtained wavelength detection result.
[0065] The principle applied to this operation gestalt here is explained.
[0066] Drawing 2 shows channel number S (location on a line sensor) of a sensor 10, and the relation of sensor signal strength. The sensor 10 is equipped with two or more light-receiving channels, and the photodetection location on a line sensor becomes settled according to the channel number which detected the light of the maximum reinforcement. In a line sensor, since the incidence locations to a line sensor differ according to wavelength, the wavelength of light is detectable from the photodetection location of a line sensor. Therefore, the wavelength of light becomes settled from the channel number which detected light.
[0067] If the variance D of a spectroscope 7 (wavelength equivalent to channel spacing of a line sensor 10) can be defined here, the difference of the channel numbers Sn or Sa which detected the criteria light Ln or La using this variance D, and the channel number S0 which detected the detected light L0 is convertible for the relative wavelength of the detected light L0 to the criteria light Ln or La. And the wavelength lambda 0 of the detected light L0 can be calculated from known wavelength lambdan (= 193.00345nm) or lambdaa (= 193.7590nm) of this relative wavelength for which it asked, and the criteria light Ln or La.
[0068] With this operation gestalt, in consideration of changing the variance D of the above-mentioned spectroscope 7 according to fluctuation of a measurement environment etc., the actual variance D is calculated and it is characterized by the point of calculating the wavelength lambda 0 of the detected light L0 based on this calculated actual variance D. With reference to the flow chart shown in drawing 3 below, it explains concretely.
[0069] As shown in this drawing 3 , first, a controller 20 makes the shutter 6 of the wavelength detection equipment shown in drawing 1 open, and carries out incidence of the detected light L0 and the criteria light Ln and La to a spectroscope 7 (step 101).
[0070] The output of a sensor 10 is read at the following step 102.
[0071] As shown in drawing 2 , from a sensor 10, the sensor channel numbers Sn, S0, and Sa corresponding to three peaks of sensor signal strength are outputted. Wavelength lambdan of the luminescence line of Neon Ne is lambdan=193.00345nm (inside of a vacuum), wavelength lambdaa of the luminescence line of Arsenic As is lambdaa=193.7590nm (inside of a vacuum) here, and lambda 0 of the luminescence line of the detected light L0 is larger than lambdan, and smaller than lambdaa (lambda0=193.3nm).
[0072] Therefore, let S0 [larger / than channel number Sn which detected the luminescence line of Neon Ne / and smaller than the channel number Sa which detected the luminescence line of Arsenic As] be the channel number which detected the oscillation laser beam L0 (step 102).
[0073] The channel numbers Sn and Sa to which it detected two criteria light Ln and La next as

Variance D (wavelength per channel of a sensor 10) showed in following the (1) type, and two criteria light Ln. It calculates using known wavelength lambdan (= 193.00345nm) of La, and lambdaa (= 193.7590nm).
[0074]
D=(lambdaa-lambdan)/(Sa-Sn) -- (1)
Next, the above-mentioned variance D is used, and as the wavelength lambda 0 of the detected light L0 shows in following the (2) type, it is asked for it.
[0075] lambda0=lambdan+ (S0-Sn) and D -- (2)
Namely, the relative wavelength (S0-Sn) and D of the detected light L0 to the criteria light Ln are calculated by carrying out the multiplication of the difference of the channel number S0 which detected the detected light S0, and channel number Sn which detected the criteria light Ln to Variance D. The wavelength lambda 0 of the detected light L0 calculates by adding known wavelength lambdan of the criteria light Ln to this relative wavelength (S0-Sn) and D. In addition, although wavelength lambdan of Neon Ne and channel number Sn are used by the above-mentioned (2) formula, wavelength lambdaa of Arsenic As and a channel number Sa may instead be used (step 104).
[0076] Since the actual variance D of a spectroscope 7 is calculated and the wavelength lambda 0 of the detected light L0 is calculated based on this actual variance D, even if individual difference is in a spectroscope 7, or it changes a measurement environment and the property of a spectroscope 7 changes according to this operation gestalt as mentioned above, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.
[0077] With the above-mentioned operation gestalt, as shown in the above-mentioned (1) formula, the case where the relation of wavelength lambda to the channel location S of a sensor 10 has an almost linearity relation is assumed.
[0078] When there is next no relation of wavelength lambda to the channel location S of a sensor 10 in linearity relation, a suitable operation gestalt is explained. For example, it uses and is suitable when the width of face per channel of a sensor 10 is not uniform.
[0079] Drawing 4 shows arrangement of the optical system inside the spectroscope at the time of using grating spectroscope 7' of a Czerny-Turner mold instead of a spectroscope 7 in drawing 1 .
[0080] If incidence of the detected light L0 and the criteria light Ln and La is carried out to spectroscope 7' as shown in this drawing 4 , incidence will be first carried out to a concave mirror M1, and incidence of the reflected light will be carried out to a grating 8. The incident angle to a grating 8 is set to alpha. The outgoing radiation angle of a grating 8 changes according to the wavelength of the light by which incidence is carried out. The outgoing radiation angle of the criteria light Ln of wavelength lambdan is set to betan, the outgoing radiation angle of the criteria light La of wavelength lambdaa is set to betaa, and the outgoing radiation angle of the detected light L0 of wavelength lambda 0 is set to beta 0. Incidence of the detected light L0 and the criteria light Ln and La which were diffracted by the grating 8 is carried out to a concave mirror M2, and the reflected light is led to a sensor 10 through a reflecting mirror 9. The focal distance of a concave mirror M2 is set to f (mm).
[0081] By the controller 20, the same processing as steps 101 and 102 is performed.
[0082] However, he makes a spectroscope 7 carry out incidence of the detected light L0 and the criteria light Ln and La to coincidence, and is trying to measure three detection locations on a sensor 10 to coincidence with this operation gestalt. And channel number Sn equivalent to peak core wavelength is calculated by interpolating three channel locations where sensor signal strength serves as a peak. Channel numbers Sa and S0 are called for by the same interpolation.
[0083] And the following processings are performed instead of steps 103 and 104.
[0084] The slot number consistency of a grating 8 is set to N (gr/mm) below, and the order of diffraction of a grating 8 is set to m. Moreover, width of face of per 1ch (channel) of the light-receiving channel of a sensor 10 is set to MCD (mm/ch).
[0085] Then, (3), (4), (5), (following 6), and following (7) type is materialized from the relation between the incident angle of a grating 8, and an outgoing radiation angle.
[0086]

N-m-lambda n=sin alpha+sinbetan -- (3)
N-m-lambda a=sin alpha+sinbetaa -- (4)
N-m-lambda 0=sin alpha+sin beta 0 -- (5)
beta a=beta n+deltabetana=beta n+dna/f -- (6)
beta0=betan+deltabetan0=betan+dn0/f -- (7)
However, they are dna= (Sn-Sa), MCDdn0= (Sn-S0), and MCD.
[0087] Therefore, from (3) type-(4) type, N-m(lambdan-lambdaa) = sinbetan-sinbetaa is obtained and it sets with N-m(lambdan-lambdaa) = sinbetan-sinbetaa=k.
[0088] If (6) types are substituted for this, sinbetan-sin (betan+dna/f) =k2sin (- dna / 2f) and cos (betan+dna / 2f) =k will be obtained. This betan=acos(k/2sin (-dna / 2f))-dna / 2f -- (8)
**********.
[0089] (3) From a formula and (8) types to sin alpha=N-m-lambda n-sinbetan -- (9)
It ******.
[0090] Moreover, it is from (7) types and (8) types. sinbeta0=sin[acos {k/2 and sin(-dna / 2f)-dna / 2f} + dn0/f] -- (10)
It ******.
[0091] therefore -- from (5), (9), and (10) types lambda0=(sin alpha+sin beta 0)/(N-m) -- (11)
Wavelength lambda 0 is computed.
[0092] Also in this operation gestalt, the wavelength lambda 0 of the detected light L0 is detectable with a sufficient precision in consideration of the actual characteristic value of spectroscope 7' as mentioned above.
[0093] As shown in drawing 2 , with the operation gestalt explained above The luminescence line Ln of wavelength lambdan=193.00345nm neon Ne with wavelength smaller than the wavelength lambda0=193.3nm detected light L0, Although the luminescence line La of wavelength lambdaa=193.7590nm arsenic As with larger wavelength than the **** detection light L0 is used as a criteria light If it is the criteria light to which wavelength is close to the detected light L0, the size of wavelength to the class (class of element) of criteria light and the detected light L0 and the number of criteria light will not be asked.
[0094] As shown in drawing 5 , the luminescence line Ln (detection channel number Sn of a sensor 10) of the neon Ne which is wavelength lambdan=193.00345nm with wavelength respectively smaller than the detected light L0, and the luminescence line Lc (detection channel number Sc of a sensor 10 (>Sn)) of wavelength lambdac=193.0905nm carbon C may be used as a criteria light.
[0095] Moreover, as shown in drawing 6 , the luminescence line Ln (detection channel number Sn of a sensor 10) of the neon Ne which is wavelength lambdan=193.00345nm with wavelength smaller than the detected light L0, and the luminescence line Lg (detection channel number Sg of a sensor 10) of the germanium germanium which is wavelength lambdag=193.4048nm with larger wavelength than the detected light L0 may be used as a criteria light.
[0096] Moreover, as shown in drawing 7 , the luminescence line Lg (detection channel number Sg of a sensor 10) of the germanium germanium which is wavelength lambdag=193.4048nm with respectively larger wavelength than the detected light L0, and the luminescence line La (channel number Sa (> Sg) of a sensor 10) of wavelength lambdaa=193.7590nm arsenic As may be used as a criteria light.
[0097] Moreover, the luminescence line Ln (detection channel number Sn of a sensor 10) of the neon Ne which is wavelength lambdan=193.00345nm with wavelength smaller than the detected light L0 as shown in drawing 8 , The luminescence line Lg (detection channel number Sg of a sensor 10) of the germanium germanium which is wavelength lambdag=193.4048nm with respectively larger wavelength than the detected light L0, Three criteria light with the luminescence line La (channel number Sa of a sensor 10) of wavelength lambdaa=193.7590nm arsenic As may be used.
[0098] Moreover, these arsenic As, Neon Ne, Germanium germanium, and Carbon C can be constructed suitably, and it can also be used as a ****** criteria light.
[0099] This can be used if there is a carbon lamp which makes Carbon C emit light as a criteria light. For example, in the case of the combination of the neon Ne shown in drawing 5 , and Carbon C, the

carbon (C) lamp which makes Neon Ne a buffer gas can be used as the criteria light source 2.
[0100] Moreover, in the case of the combination of the neon Ne shown in drawing 6 , and Germanium germanium, the germanium (germanium) lamp which makes Neon Ne a buffer gas can be used as the criteria light source 2.
[0101] Moreover, in the case of the combination of the arsenic As shown in drawing 7 , and Germanium germanium, the hollow cathode lamp with which Arsenic As and Germanium germanium were mixed can be used as the criteria light source 2.
[0102] Moreover, as shown in drawing 8 , in the case of the combination of Neon Ne, Germanium germanium, and Arsenic As, the lamp containing each element which emits light near these 193nm can be used as the criteria light source.
[0103] drawing 8 -- being shown -- as -- three -- a ** -- an element -- criteria -- light -- having used it -- a case -- **** -- two -- a ** -- an element -- sequential -- selection -- carrying out -- having mentioned above -- (-- one --) -- a formula -- from -- a spectroscope -- seven -- a variance -- D -- asking -- supposing -- three -- a ** -- a variance -- D -- one -- D -- two -- D -- three -- obtaining -- having . In this case, what is necessary is just to determine the average of these three variances D1, D2, and D3 as the variance D of the final spectroscope 7.
[0104] As shown in drawing 2 , when the wavelength lambda 0 of the detected light L0 exists between wavelength lambdan of two criteria light Ln and La, and lambdaa, the advantage that it can ask for the wavelength lambda 0 of the detected light L0 with a sufficient precision with interpolation is acquired. This is because the relation between each sensor location of a line sensor 10 and wavelength is not completely linearity. In addition, since it is extrapolated when the wavelength lambda 0 of the detected light L0 exists out of between wavelength lambdan of two criteria light Ln and Lc, and lambda c, as shown in drawing 5 , the detection precision of the wavelength lambda 0 of the detected light L0 will be a little inferior.
[0105] Moreover, although the arsenic lamp with which neon gas was enclosed as a buffer gas is used as the criteria light source 2 and it is made to carry out the radiant power output of two kinds of criteria light from the one criteria light source 2 with the operation gestalt mentioned above, the operation to which the radiant power output of the criteria light is carried out from the separate criteria light source is also possible.
[0106] Drawing 9 shows the example of a configuration which used the two criteria light sources 11 and 12.
[0107] As shown in this drawing 9 , the arsenic lamp 11 which carries out the radiant power output of the luminescence line La of wavelength lambdaa=193.7590nm arsenic As, and the neon glow lamp 12 which carries out the radiant power output of the luminescence line Ln of wavelength lambdan=193.00345nm neon Ne are prepared as the criteria light sources 11 and 12, and incidence of the light by which the radiant power output was carried out from each criteria light sources 11 and 12 is carried out to an integrating sphere 13. Similarly, the radiant power output of the wavelength lambda0=193.3nm detected light L0 is carried out from the detected light source 1, and incidence is carried out to an integrating sphere 13 through a lens 3. Incidence to the integrating sphere 13 of the light L0 detected [these] and the criteria light La and Ln is performed to coincidence.
[0108] In an integrating sphere 13, scattered reflection of the light by which incidence was carried out is carried out, and they is scattered about uniformly. Therefore, it mixes uniformly within an integrating sphere 13, and incidence of two criteria light La and Ln and detected light L0 is carried out to a spectroscope 7 through a lens 14 from the one light source. Since it is the same as that of the operation gestalt mentioned above about the processing after incidence was carried out to light into the spectroscope 7, the explanation is omitted.
[0109] As for two criteria light La and Ln mentioned above and detected light L0, it is desirable to carry out incidence to coincidence. It is because the property of the spectroscope 7 changed according to an environment can be measured on real time.
[0110] The wavelength detection equipment which used the FAPURIPERO etalon spectroscope next is explained with reference to drawing 10 and drawing 11 .

[0111] As shown in drawing 10 , with this wavelength detection equipment, through a lens 3, it is reflected in part by the beam splitter 5, and the oscillation laser beam L0 which is a detected light outputted from the detected light source 1 is irradiated by the diffusion plate 15. From the diffusion plate 15, it is scattered about, and outgoing radiation of the detected light L0 is carried out, and it is irradiated by the etalon 16. The criteria light Ln (luminescence line of Neon Ne) and La (luminescence line of Arsenic As) outputted from the criteria light source 2 on the other hand is irradiated through a lens 4 by the back etalon 16 which the part was penetrated by the beam splitter 5 and diffused with the diffusion plate 15. The etalon 16 consists of two transparence plates with which the inside field was used as the partial reflection mirror here. An etalon 16 makes the criteria light Ln and La and the detected light L0 from which wavelength differs penetrate.
[0112] Incidence of the light which penetrated the etalon 16 is carried out to a condenser lens 17. This condenser lens 17 is an achromatic lens with which for example, chromatic-aberration amendment was performed, and chromatic aberration is amended by passing through an achromatic condenser 17.
[0113] The line sensor 18 is arranged on the focus of a condenser lens 17. Image formation of the light which passed through the condenser lens 17 by this is carried out on a line sensor 18, and it forms interference fringe 19b corresponding to interference fringe 19a corresponding to wavelength lambdaa of the criteria light La (arsenic As), and wavelength lambdan of the criteria light Ln (neon Ne), and interference fringe 19c corresponding to the wavelength lambda 0 of the detected light L0 on the detection side on this line sensor 18. These interference fringes are formed in concentric circular on a line sensor 18.
[0114] The radius from the center position of the line sensor 18 of interference fringe 19a corresponding to Arsenic As is Ra, this radius of interference fringe 19b corresponding to Neon Ne is Rn, and this radius of interference fringe 10c corresponding to the detected light L0 is R0.
[0115] In a line sensor 18, the radii Ra, Rn, and R0 from a line sensor core to each interference fringe image formation location are detected.
[0116] As shown in drawing 11 here, the square R2 of the radius R from a line sensor core to an interference fringe image formation location and the relation of the wavelength lambda of light by which image formation was carried out to the line sensor 18 are theoretically approximated to linearity relation.

[0117] That is, the relation between the squares Rn2 and Ra2 of the radius of the interference fringes 19b and 19a of the criteria light Ln and La, and wavelength lambdan and lambdaa is expressed with a linearity function, and can ask for the multiplier. Specifically, the inclination of a straight line Q becomes settled.
[0118] Therefore, square R02 of a straight line Q to the radius which can ask for the square R02 of a radius by this, and is shown in drawing 11 since the image formation location R0 of interference fringe 19c of the detected light L0, i.e., the radius of interference fringe 19c, is now detected by the line sensor 18 It can ask for the corresponding wavelength lambda 0 as wavelength of the detected light L0.
[0119] In addition, although the explanation mentioned above explained the case where the oscillation laser beam of argon fluorine (ArF) excimer laser was made into a detected light, when making the oscillation laser beam of krypton fluorine (KrF) excimer laser into the detected light L0, the wavelength lambda 0 of the detected light L0 can be similarly detected using the criteria light source which outputs the luminescence line of the wavelength close to wavelength lambda0=248.4nm. For example, the iron (Fe) lamp which outputs the luminescence line of level by which iron (Fe) differs as the criteria light source 2 can be used. From an iron (Fe) lamp, the wavelength of 248.2371nm and two 248.4188nm luminescence lines are outputted.
[0120] In addition, instead of the spectroscope 7 of the diffraction-grating mold shown in drawing 1 , spectroscope 7" of the diffraction-grating mold shown in drawing 12 may be used.
[0121] By the way, although he is trying to use the luminescence line of Neon Ne, Arsenic As, Carbon C, and Germanium germanium as a criteria light, you may make it use the luminescence line of Platinum Pt as a criteria light with the operation gestalt mentioned above.
[0122] In addition, a hollow cathode lamp can be used as the light source which outputs the

luminescence line of Platinum Pt.
[0123] As shown in drawing 13 , Platinum Pt has the luminescence lines LP1, LP2, and LP3 which are three from which wavelength differs.
[0124] The wavelength of each three luminescence lines LP1, LP2, and LP3 outputted from a platinum lamp is lambdaP1=193.4369nm (channel number SP1 of a sensor 10), lambdaP2=193.2243nm (channel number SP2 of a sensor 10), and lambdaP3=193.7245nm (channel number SP3 of a sensor 10), and is approximated to wavelength lambda0=193.3nm of an argon fluorine excimer laser luminescence line.
[0125] For this reason, it is possible to use only one luminescence line as a criteria light among each three luminescence lines LP1, LP2, and LP3.
[0126] However, if two or more luminescence lines are used as a criteria light among each three luminescence lines LP1, LP2, and LP3, the variance D of a spectroscope 7 can be calculated like the operation gestalt mentioned above, and the wavelength lambda 0 of the detected light L0 outputted still further from the detected light source 1 can be detected with a without error and sufficient precision.
[0127] Now, although he is trying to use a luminescence line as a criteria light for detecting the wavelength of argon fluorine excimer laser with the operation gestalt explained above, the wavelength of argon fluorine excimer laser may be detected using the absorption line.
[0128] Drawing 14 and 15 are drawings showing the operation gestalt of the wavelength detection equipment which detects the wavelength of argon fluorine excimer laser using the absorption line. However, drawing 15 is drawing showing an operation gestalt when the spectral line width of the absorption line is narrower than the spectral line width of argon fluorine excimer laser.
[0129] From the detected light source 1 which is argon fluorine excimer laser equipment, the oscillation laser beam L0 of predetermined power is injected as a detected light L0 through the front mirror 21.
[0130] On the other hand, the steamy gas of the platinum Pt which has the absorption lines (wavelength lambdaP1=193.4369nm, lambdaP2=193.2243nm, and lambdaP3=193.7245nm) BP1, BP2, and BP3 is enclosed with the absorption cell 23 as the absorption line to the luminescence line of argon fluorine excimer laser.
[0131] Here, the wavelength lambdaP1 of the absorption lines BP1, BP2, and BP3 of platinum Pt gas, lambdaP2, and lambdaP3 are the same as that of the value of the wavelength of the luminescence lines LP1, LP2, and LP3 shown in drawing 13 at drawing 13 , and are approximated to wavelength lambda0=193.3nm of the luminescence line L0 of argon fluorine excimer laser.
[0132] For this reason, the absolute wavelength of the oscillation laser beam L0 is detectable by adjusting the wavelength lambda 0 of the narrow-band-ized oscillation laser beam L0 to the wavelength of the one or more absorption lines among the wavelength lambdaP1 of the above-mentioned absorption lines BP1, BP2, and BP3, lambdaP2, and lambdaP3.
[0133] In addition, the wavelength of the absorption line of Neon Ne, Arsenic As, Carbon C, and Germanium germanium is also approximated to wavelength lambda0=193.3nm of the luminescence line L0 of argon fluorine excimer laser besides absorption-lines [of Platinum Pt] BP1 and BP2, and BP3.
[0134] The wavelength of the absorption line of these neon Ne, Arsenic As, Carbon C, and Germanium germanium is the same as that of the value of the wavelength of the luminescence line which is shown in drawing 2 , drawing 5 , drawing 6 , drawing 7 R> 7, and drawing 8 and which was mentioned above.
[0135] For this reason, the absolute wavelength of the oscillation laser beam L0 is also detectable by adjusting the wavelength lambda 0 of the narrow-band-ized oscillation laser beam L0 to the wavelength of the one or more absorption lines among wavelength lambdaa of the absorption lines Ba, Bn, Bc, and Bg of the above-mentioned arsenic As, Neon Ne, Carbon C, and Germanium germanium, lambdan, lambdac, and lambdag.
[0136] Incidence of the detected light L0 is carried out to beam splitter 5a in the monitor module 22. It is reflected by beam splitter 5a, and incidence of a part of detected light L0 is carried out to beam splitter 5b. A part of detected light L0 penetrates beam splitter 5b, and incidence is carried out to an absorption cell 23. Moreover, after the remaining detected light L0 reflected by beam splitter 5b is irradiated by diffusion plate 15b, it is scattered about and the optical reinforcement is detected by the photodiode 24. And the detected light L0 which passed the absorption cell 23 is irradiated by diffusion plate 15a. From

diffusion plate 15a, it is scattered about, and outgoing radiation of the detected light L0 is carried out, and incidence is carried out into a spectroscope 7. And as mentioned above, according to the channel number which detected the light of the maximum reinforcement by two or more light-receiving channels on the sensor 10, the detection location of the detected light L0 on a line sensor becomes settled, and the wavelength lambda 0 of the detected light L0 becomes settled from the channel number which detected the detected light L0.

[0137] By having made the absorption cell 23 (platinum Pt gas being enclosed) penetrate the detected light L0 of the argon fluorine excimer laser of spontaneous emission, drawing 15 shows signs that optical reinforcement of the luminescence line of the detected light L0 is made into the minimum by the absorption lines BP1, BP2, and BP3 of spectral line width narrower than the spectral line width of the luminescence line L0.

[0138] In addition, when enclosing platinum Pt gas, a through type hollow cathode lamp may be used.

[0139] The sensor 10 is equipped with two or more light-receiving channels, and the photodetection location on a sensor 10 becomes settled according to the channel number which detected the light of the maximum reinforcement. By the sensor 10, since the incidence locations to a sensor 10 differ according to wavelength, the wavelength of light is detectable from the photodetection location of a sensor 10. Therefore, the wavelength of light becomes settled from the channel number which detected light.

[0140] Platinum Pt gas shall be now enclosed with the absorption cell 23. In this case, after the detected light L0 passes platinum Pt gas, incidence is carried out to a spectroscope 7 through diffusion plate 15a, and the optical reinforcement of that spectrum is detected by channel number SP on a sensor 10.

[0141] In this case, the spectral line width W1 and W2 narrower than the luminescence line breadth W0 of the detected light L0 and the absorption lines BP1, BP2, and BP3 of W3 are contained in the luminescence line breadth W0 of the detected light L0. That is, in the wavelength lambda luminescence line breadth W0 of the detected light L0 which has 0= 193.3nm, wavelength lambdaP1=193.4369nm of Platinum Pt, lambdaP2=193.2243nm, and lambdaP3=193.7245nm are contained respectively. Therefore, optical reinforcement of the part equivalent to wavelength lambdaP1=193.4369nm in the luminescence line of the detected light L0, lambdaP2=193.2243nm, and lambdaP3=193.7245nm is made into the minimum by the absorption lines BP1, BP2, and BP3.

[0142] Moreover, gas, such as Arsenic As, Neon Ne, Carbon C, or Germanium germanium, shall be enclosed with the absorption cell 23, for example.

[0143] In this case, the absorption lines Ba, Bn, Bc, and Bg of spectral line width narrower than the luminescence line breadth W0 of the detected light L0 are also contained in the luminescence line breadth W0 of the detected light L0. That is, in the wavelength lambda luminescence line breadth W0 of the detected light L0 which has 0= 193.3nm, wavelength lambdaa=193.7590nm of Arsenic As, wavelength lambdan=193.00345nm of Neon Ne, wavelength lambdac=193.0905nm of Carbon C, and wavelength lambdag=193.4048nm of Germanium germanium are contained respectively. Therefore, optical reinforcement of the part equivalent to wavelength lambdaa=193.7590nm in the luminescence line of the detected light L0, lambdan=193.00345nm, lambdac=193.0905nm, and lambdag=193.4048nm is made into the minimum by the absorption lines Ba, Bn, Bc, and Bg.

[0144] Drawing 16 is drawing showing an operation gestalt when the spectral line width of the absorption line is wider than the spectral line width of argon fluorine excimer laser.

[0145] Also in this case, the oscillation laser beam L0 of predetermined power is injected as a detected light L0 through the front mirror 21 from the detected light source 1 which is argon fluorine excimer laser equipment.

[0146] And incidence of the detected light L0 is carried out to beam splitter 5a in the monitor module 22. It is reflected by beam splitter 5a, and incidence of a part of detected light L0 is carried out to beam splitter 5b. A part of detected light L0 penetrates beam splitter 5b, and incidence is carried out to beam splitter 5c. Moreover, after the remaining detected light L0 reflected by beam splitter 5b is irradiated by diffusion plate 15b, it is scattered about and the optical reinforcement is detected by the photodiode 24. It is reflected by beam splitter 5c, and incidence of a part of detected light L0 is carried out to an absorption cell 23. And the detected light L0 penetrates an absorption cell 23, and the optical

reinforcement is detected by the light-intensity detector 25.
[0147] On the other hand, a part of detected light L0 which penetrated beam splitter 5c is irradiated by diffusion plate 15a. From diffusion plate 15a, it is scattered about, and outgoing radiation of the detected light L0 is carried out, and incidence is carried out into a spectroscope 7. And the wavelength lambda 0 of the detected light L0 becomes settled from the channel number which detected the optical reinforcement of the detected light L0 on the sensor 10 as mentioned above.
[0148] By having made the absorption cell 23 (platinum Pt gas being enclosed) penetrate the detected light L0 of argon fluorine excimer laser, drawing 17 shows signs that optical reinforcement of the luminescence line of the detected light L0 is made the minimum by the absorption line BP1 of spectral line width larger than the spectral line width of the luminescence line L0, or BP2 or BP3.
[0149] A light-intensity detector 25 should just detect optical reinforcement. For example, they are a photodiode, a photomultiplier, etc.
[0150] Platinum Pt gas shall be now enclosed with the absorption cell 23. And after the optical reinforcement of the detected light L0 passes platinum Pt gas, the optical reinforcement is detected by the light-receiving channel on a light-intensity detector 25.
[0151] At this time, the luminescence line of the detected light L0 is made into the optical minimum reinforcement H2 from the optical reinforcement H1 by the absorption line of the spectral line width W1 or W2 larger than the luminescence line breadth W0 of the detected light L0, or W3.
[0152] Moreover, gas, such as Arsenic As, Neon Ne, Carbon C, or Germanium germanium, shall be enclosed with the absorption cell 23, for example. At this time, after the optical reinforcement of the detected light L0 passes arsenic As gas, neon Ne gas, carbon C gas, or germanium germanium gas, that optical reinforcement is detected by the light-receiving channel on a light-intensity detector 25. And the luminescence line of the detected light L0 is made into the optical minimum reinforcement H2 from the optical reinforcement H1 by the absorption lines, such as the arsenic As of spectral line width larger than the luminescence line breadth W0 of the detected light L0, Neon Ne, Carbon C, or Germanium germanium.
[0153] Next, processing of wavelength detection of the oscillation laser beam L0 using the three absorption lines BP1, BP2, and BP3 of the platinum Pt of spectral line width narrower than the luminescence line breadth of argon fluorine excimer laser is explained with reference to drawing 14 , drawing 18 , and drawing 19 by making into an example the case where platinum Pt gas is enclosed in an absorption cell 23.
[0154] Drawing 18 (a) is the flow chart of wavelength control of the oscillation laser beam L0 which used the absorption line, and this drawing (b) is drawing showing the relation between the oscillation wavelength lambda 0 and optical reinforcement.
[0155] In the flow chart of drawing 18 (a), the wavelength calibration subroutine which the controller 20 first shown in drawing 21 fixes to the wavelength aiming at the main wavelength lambda 0 of the spectrum of the oscillation laser beam L0 based on the command signal from the outside is performed (step 200).
[0156] If a wavelength calibration subroutine is performed, the oscillation wavelength lambda 0 of the oscillation laser beam L0 will emit light by predetermined preliminary-waves length (step 201).
[0157] Next, the absorption cell 23 by which platinum Pt gas is enclosed in the monitor module 22 shown in drawing 14 is penetrated, and the optical reinforcement of the oscillation laser beam L0 which passed diffusion plate 15a and a spectroscope 7 is called for on a sensor 10. According to the channel number which detected the light of the maximum reinforcement at this time, the photodetection location on a sensor 10 becomes settled. However, the channel number on the sensor 10 which detects the optical reinforcement of the spectrum of an oscillation laser beam changes according to change of the oscillation wavelength lambda 0 (step 202).
[0158] Next, only an amount predetermined in the oscillation wavelength lambda 0 of the oscillation laser beam L0 from preliminary-waves length changes with controllers 20. The minimum points Z2, Z1, and Z3 that the optical reinforcement of the spectrum of the oscillation laser beam L0 becomes the minimum by this are looked for one by one (step 203).

[0159] And it is judged whether the oscillation wavelength lambda 0 turned into proofreading termination wavelength (step 204).
[0160] the case where it is judged with the oscillation wavelength lambda 0 of the oscillation laser beam L0 not being proofreading termination wavelength -- (the decision NO of step 204) -- it shifts to step 202 and step 203 again, and only an amount further predetermined in the oscillation wavelength lambda 0 of the oscillation laser beam L0 changes. On the other hand, when the oscillation wavelength lambda 0 of the oscillation laser beam L0 turns into proofreading termination wavelength, as shown in (the decision YES of step 204) and drawing 18 (b), the data d of the relation between the oscillation wavelength lambda 0 and optical reinforcement are plotted (step 205).
[0161] And optical reinforcement of the spectrum of the oscillation laser beam L0 detected on the sensor 10 as shown in the points Z1, Z2, and Z3 of the data d of drawing 18 (b) is made into the minimum by the absorption lines BP1, BP2, and BP3. Since the wavelength of the minimum points Z1, Z2, and Z3 is wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm, and lambdaP3=193.7245nm The main wavelength lambda 0 of the spectrum of the oscillation laser beam L0 by which incidence is carried out to the light-receiving channels Sz1, Sz2, and Sz3 on the sensor 10 corresponding to the location of the minimum points Z1, Z2, and Z3 Wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm, It is proofread by lambdaP3=193.7245nm. Thereby, the light-receiving channels Sz1, Sz2, and Sz3 on the sensor 10 corresponding to the location of the minimum points Z1, Z2, and Z3 become clear. Moreover, the wavelength difference between the light-receiving channels on a sensor 10 can be decided by the distance of a spectroscope 7 and a sensor 10, and the property of a lens, and can be expressed with a constant delta. Therefore, the wavelength lambda 0 of the strange oscillation laser beam L0 by which optical reinforcement is detected on a sensor 10 Wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm, and lambdaP3=193.7245nm, X1, X2, and X3 channels between the light-receiving channels Sz1, Sz2, and Sz3 and the light-receiving channel SP by which the wavelength lambda 0 of the strange oscillation laser beam L0 is detected, a constant delta -- using -- (12), (following 13), and following (14) type and
lambda01=193.4369**X1xdelta -- (12)
lambda02=193.2243**X2xdelta -- (13)
lambda03=193.7245**X3xdelta -- (14)
It can ask depending on whether it is ********. Moreover, the average of three wavelength lambda01, lambda02, and lambda02 for which it asked respectively from each above-mentioned formula can be calculated as wavelength lambda 0 of the final strange oscillation laser beam L0. Furthermore, since the two or more absorption lines are used, the variance D of a spectroscope 7 can be calculated like the operation gestalt using two or more criteria light mentioned above (step 206).
[0162] Next, processing of wavelength detection of the oscillation laser beam L0 using the absorption lines BP1, BP2, and BP3 of the platinum Pt of spectral line width larger than the luminescence line breadth of argon fluorine excimer laser is explained with reference to drawing 16 , drawing 18 , and drawing 19 .
[0163] Processing to steps 200-201 shown in drawing 18 (a) first mentioned above is performed.
[0164] Next, the optical reinforcement of the spectrum of the oscillation laser beam L0 which penetrated the absorption cell 23 by which platinum Pt gas is enclosed in the monitor module 22 shown in drawing 16 is detected on a light-intensity detector 25 (step 202).
[0165] Next, only an amount predetermined in the oscillation wavelength lambda 0 of the oscillation laser beam L0 from preliminary-waves length changes with the controllers 20 shown in drawing 19 . The minimum point that the optical reinforcement of the spectrum of the oscillation laser beam L0 detected on a light-intensity detector 25 by this becomes the minimum is looked for (step 203).
[0166] Next, processing to steps 204-205 shown in drawing 18 (a) mentioned above is performed.
[0167] Consequently, the oscillation wavelength lambda 0 of the oscillation laser beam L0 by which incidence is carried out to the light-receiving channels Sz1, Sz2, and Sz3 on a sensor 10 when optical reinforcement of the spectrum of the oscillation laser beam L0 detected on a light-intensity detector 25

at step 203 is made into the minimum by the absorption lines BP1, BP2, and BP3 is set to the wavelength lambdaP1 of the absorption lines BP1, BP2, and BP3, lambdaP2, and lambdaP3. Therefore, the wavelength lambda 0 of the strange oscillation laser beam L0 by which optical reinforcement is detected on a sensor 10 Wavelength lambdaP1=193.4369nm of the absorption lines BP1, BP2, and BP3, lambdaP2=193.2243nm and lambdaP3=193.7245nm X1, X2, and X3 channels between the light-receiving channels Sz1, Sz2, and Sz3 and the light-receiving channel SP by which the wavelength lambda 0 of the strange oscillation laser beam L0 is detected, and the above-mentioned constant delta are used. Above (12), It can ask similarly from (13) and (14) types as wavelength lambda 0 of the final strange oscillation laser beam L0 (step 206).

[0168] In addition, in case it asks for the wavelength lambda 0 of the strange oscillation laser beam L0, the one absorption line or the two absorption lines may be used among the three absorption lines BP1, BP2, and BP3 of Platinum Pt.

[0169] However, if two or more of the three absorption lines BP1, BP2, and BP3 are used like the operation gestalt mentioned above, the variance D of a spectroscope 7 can be calculated, and the wavelength lambda 0 of the detected light L0 outputted still further from the detected light source 1 can be detected with a without error and sufficient precision.

[0170] As explained above, in argon fluorine excimer laser, the one or more absorption lines are used as the absorption line as the absorption line to said argon fluorine excimer laser luminescence line among the absorption lines of Platinum Pt, Arsenic As, Neon Ne, Carbon C, and Germanium germanium to detect wavelength lambda0=193.3nm of the oscillation laser beam L0.

[0171] Even if individual difference is in a spectroscope 7 by this, or a measurement environment carries out fluctuation etc. and the property of a spectroscope 7 changes, the wavelength lambda 0 of the detected light L0 outputted from the detected light source 1 is detectable with a without error and sufficient precision.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the characteristic value of the spectroscope on a design differs from the characteristic value of each actually manufactured spectroscope a little. That is, the error is included in the theoretical variance Dt by the individual difference of a spectroscope.
[0018] moreover, the property of a spectroscope -- change of temperature, and the change equimeasure of a pressure -- a law -- it changes according to an environmental change. For example, when temperature changes, spacing of the slot on the grating changes. Moreover, change of a pressure changes the rate of optical refraction in air. For this reason, the relation between the detection location of a sensor and wavelength is changed by change of temperature and a pressure.
[0019] Originating in fluctuation of the property of the spectroscope by the difference between the property of the spectroscope on a design, and the property of each actually manufactured spectroscope, and fluctuation of a measurement environment etc. as mentioned above, the actual variance D of a spectroscope shows a different value in the theoretical variance Dt. Therefore, noting that the property of a spectroscope is known (i.e., ****** [the theoretical variance Dt is known]) It asks for the relative wavelength of the detected light L0 to the criteria light La from the difference of the detection channel number Sa of the criteria light La, and the detection channel number S0 of the detected light L0. When this relative wavelength for which it asked, and the wavelength lambda 0 of known wavelength lambdaa (193.696nm) of the criteria light La to the detected light L0 are calculated, a detection error will be included in this wavelength lambda 0 for which it asked. Although wavelength lambda 0 is asked for the detection precision of 0.0001nm order, it cannot respond to this request.
[0020] Even if this invention is made in view of such the actual condition, and individual difference is in a spectroscope, or you change a measurement environment and the property of a spectroscope changes, let it be a solution technical problem to enable it to detect the wavelength of a detected light outputted from the detected light source with a without error and sufficient precision.

[Translation done.]

DESCRIPTION OF DRAWINGS

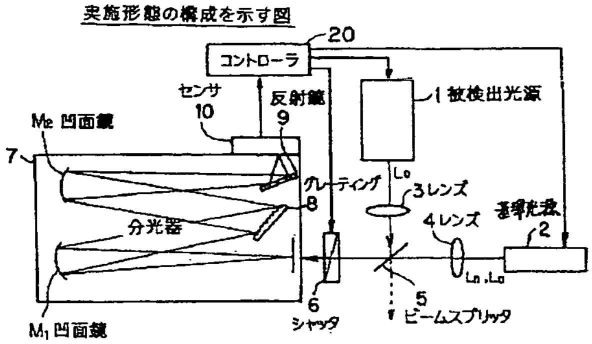
[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is drawing showing the configuration of the operation gestalt of the wavelength detection equipment concerning this invention.
[Drawing 2] Drawing 2 is drawing showing the relation between the sensor channel number at the time of using the criteria light source which outputs the luminescence line of neon and arsenic, and sensor signal strength.
[Drawing 3] Drawing 3 is a flow chart which shows the procedure of processing of calculating the wavelength of a detected light.
[Drawing 4] Drawing 4 is drawing showing the arrangement configuration of the optical system in a spectroscope.
[Drawing 5] Drawing 5 is drawing showing the relation between the sensor channel number at the time of using the criteria light source which outputs the luminescence line of neon and carbon, and sensor signal strength.
[Drawing 6] Drawing 6 is drawing showing the relation between the sensor channel number at the time of using the criteria light source which outputs the luminescence line of neon and germanium, and sensor signal strength.
[Drawing 7] Drawing 7 is drawing showing the relation between the sensor channel number at the time of using the criteria light source which outputs the luminescence line of germanium and arsenic, and sensor signal strength.
[Drawing 8] Drawing 8 is drawing showing the relation between the sensor channel number at the time of using the criteria light source which outputs the luminescence line of neon, germanium, and arsenic, and sensor signal strength.
[Drawing 9] Drawing 9 is drawing showing the example of a configuration of the wavelength detection equipment which used two criteria lamps.
[Drawing 10] Drawing 10 is drawing showing the example of a configuration of the wavelength detection equipment which used the FAPURIPERO etalon spectroscope.
[Drawing 11] Drawing 11 is drawing showing the relation between the square of the radius of an interference fringe, and wavelength.
[Drawing 12] Drawing 12 is drawing showing the modification of the diffraction-grating mold spectroscope concerning this invention.
[Drawing 13] Drawing 13 is drawing showing the relation between the sensor channel number at the time of using the criteria light source which outputs the luminescence line of platinum, and sensor signal strength.
[Drawing 14] Drawing 14 is drawing showing the configuration of the operation gestalt of the wavelength detection equipment concerning this invention.
[Drawing 15] Drawing 15 is drawing having shown signs that optical reinforcement of the luminescence line of argon fluorine excimer laser was made into the minimum by two or more absorption lines of spectral line width narrower than the spectral line width of a luminescence line.

[Drawing 16] Drawing 16 is drawing showing the modification of the operation gestalt of the wavelength detection equipment shown in drawing 15 .
[Drawing 17] Drawing 17 is drawing having shown signs that optical reinforcement of the luminescence line of argon fluorine excimer laser was made into the minimum by the absorption line of spectral line width larger than the spectral line width of a luminescence line.
[Drawing 18] Drawing 18 (a) is drawing showing the flow chart of wavelength control of the oscillation laser beam which used the absorption line, and drawing 18 (b) is drawing showing the relation between oscillation wavelength and optical reinforcement.
[Drawing 19] Drawing 19 is drawing showing the wavelength stabilization control unit of common laser.
[Drawing 20] Drawing 20 is drawing explaining the conventional technique, and is drawing showing the relation between a sensor channel number and sensor signal strength.
[Description of Notations]
1 Detected Light Source
2 Criteria Light Source
7 7' Spectroscope
10 18 Sensor

[Translation done.]

Drawing selection drawing 1

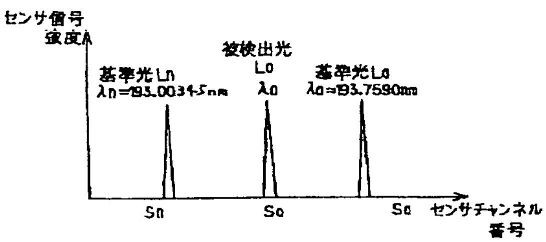
実施形態の構成を示す図



[Translation done.]

Drawing selection drawing 2

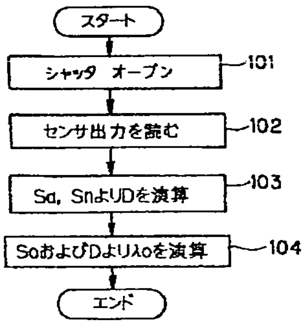
センサチャンネルとセンサ信号強度の関係を示す図



[Translation done.]

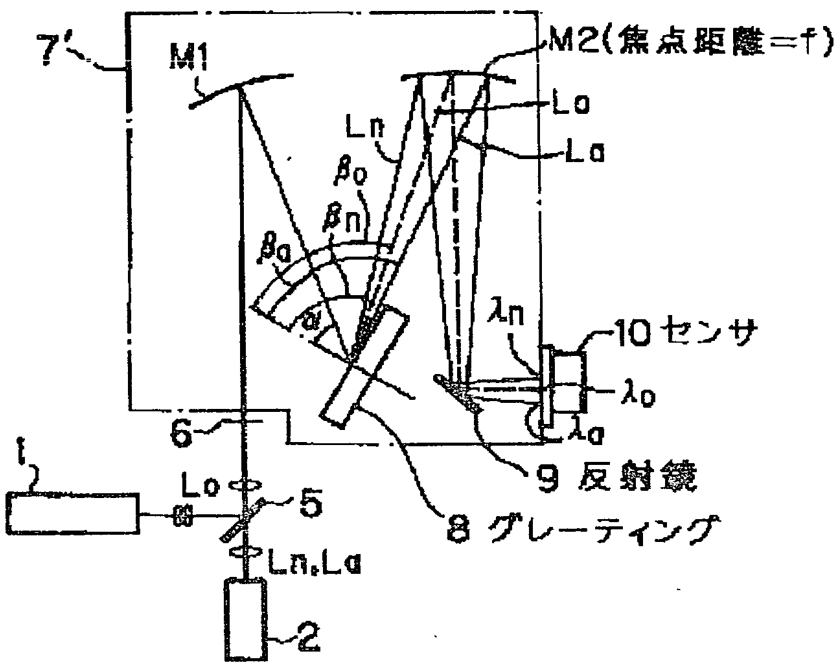
Drawing selection drawing 3

被検出光の波長を演算する処理を示す図



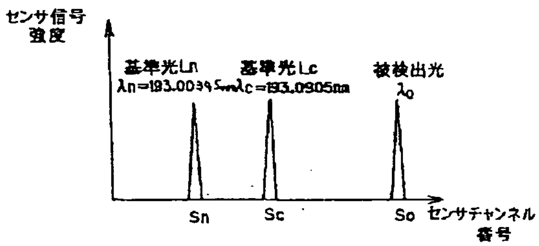
[Translation done.]

分光器における光学系の配置を示す図



Drawing selection drawing 5

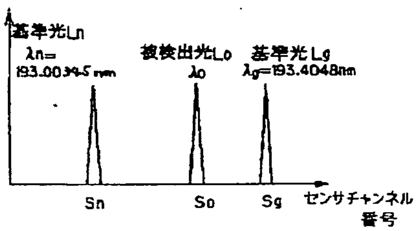
センサチャンネルとセンサ信号強度の関係を示す図



[Translation done.]

Drawing selection drawing 6

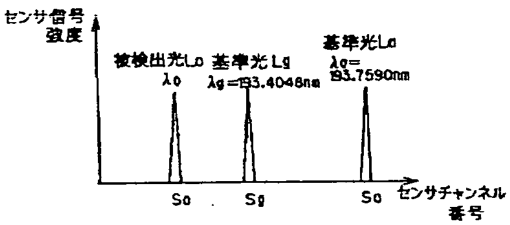
センサチャンネルとセンサ信号強度の関係を示す図



[Translation done.]

Drawing selection drawing 7

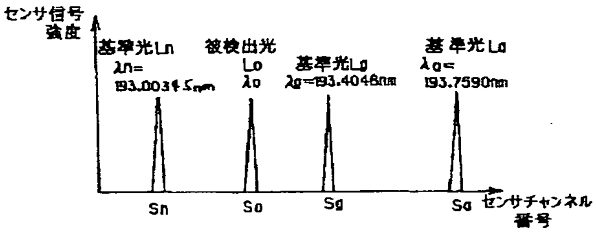
センサチャンネルとセンサ信号強度の関係を示す図



[Translation done.]

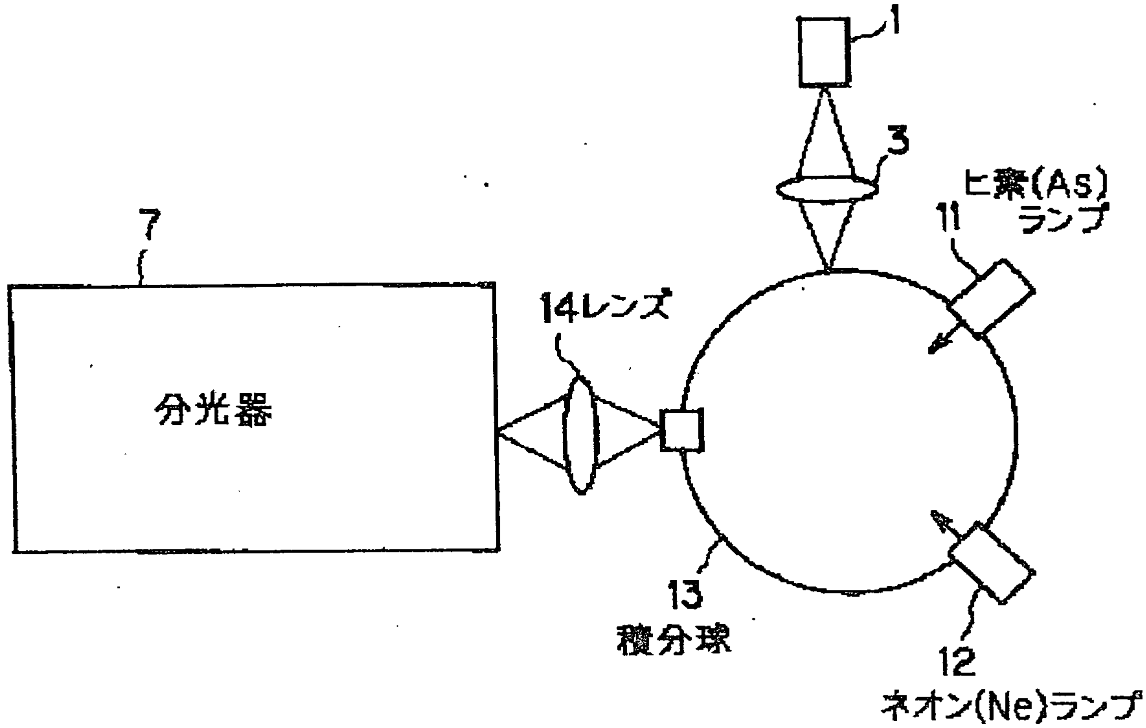
Drawing selection drawing 8

センサチャンネルとセンサ信号強度の関係を示す図



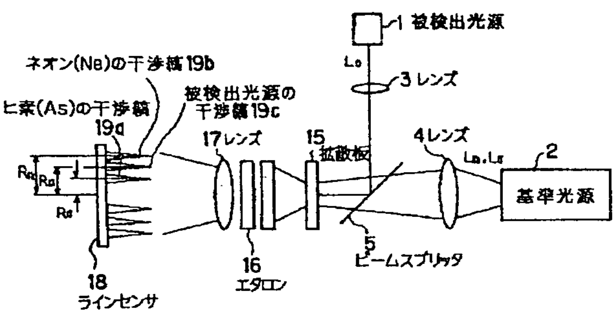
[Translation done.]

2個の基準ランプを使用する構成例を示す図



Drawing selection drawing 10

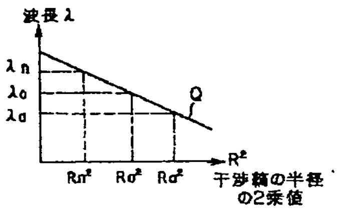
ファブリープロエタロン分光器を使用した構成例を示す図



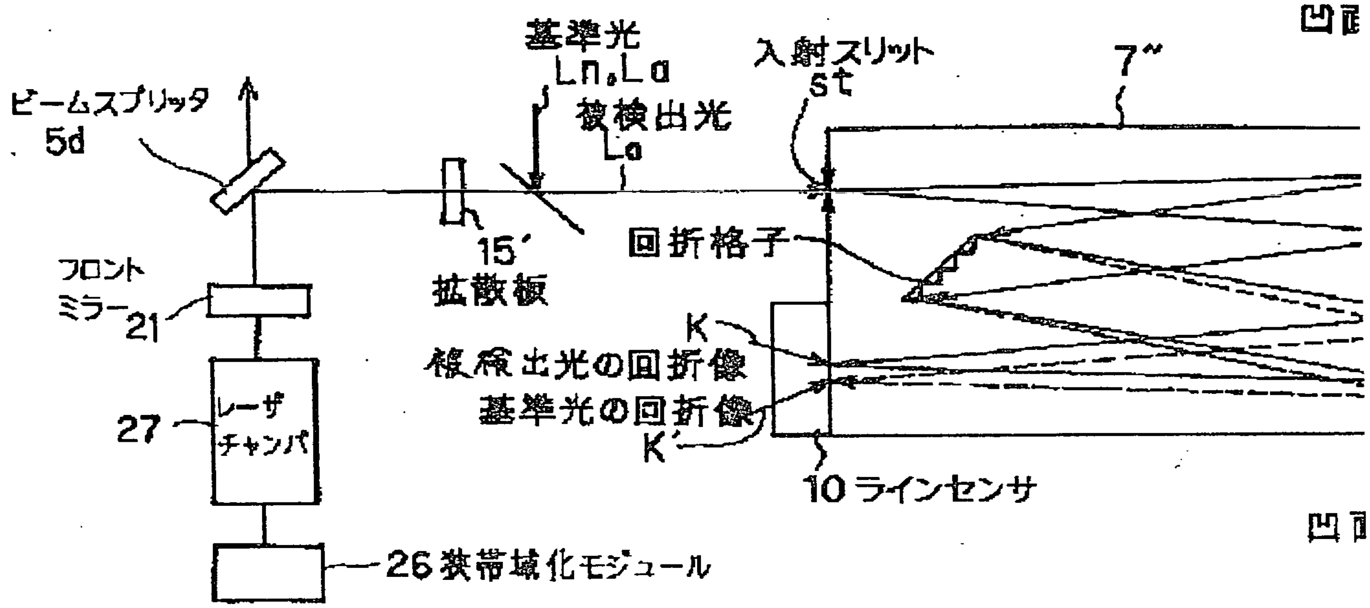
[Translation done.]

Drawing selection drawing 11

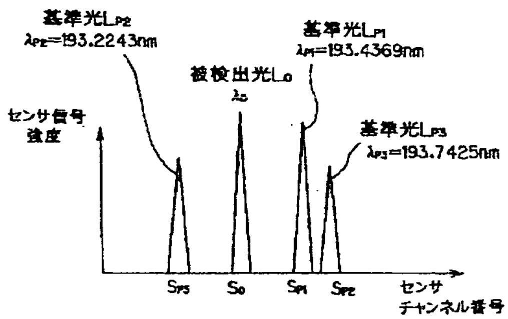
干渉縞の半径の2乗値と波長の関係を示す図



[Translation done.]

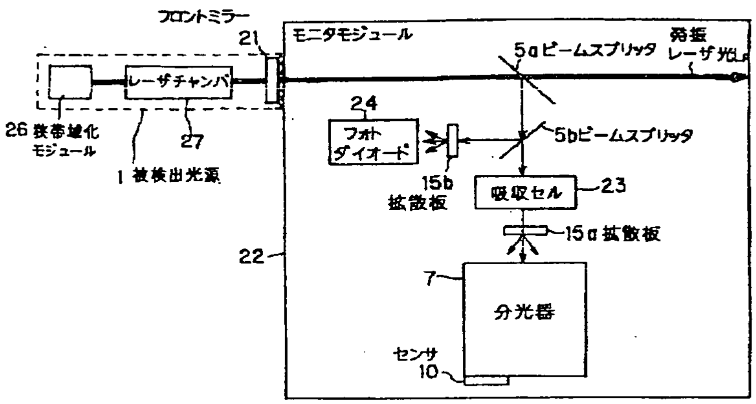

ビームスプリッタ
5d
基準光
Ln,La
被検出光
La
入射スリット
st
7"
15'
拡散板
回折格子
フロント
ミラー
21
K
被検出光の回折像
基準光の回折像
K'
27
レーザ
チャンバ
10 ラインセンサ
26 狭帯域化モジュール

Drawing selection drawing 13



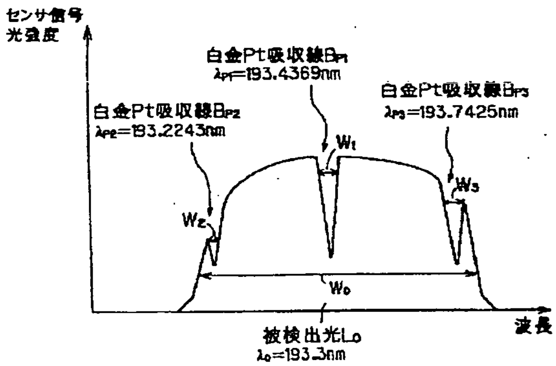
[Translation done.]

Drawing selection drawing 14

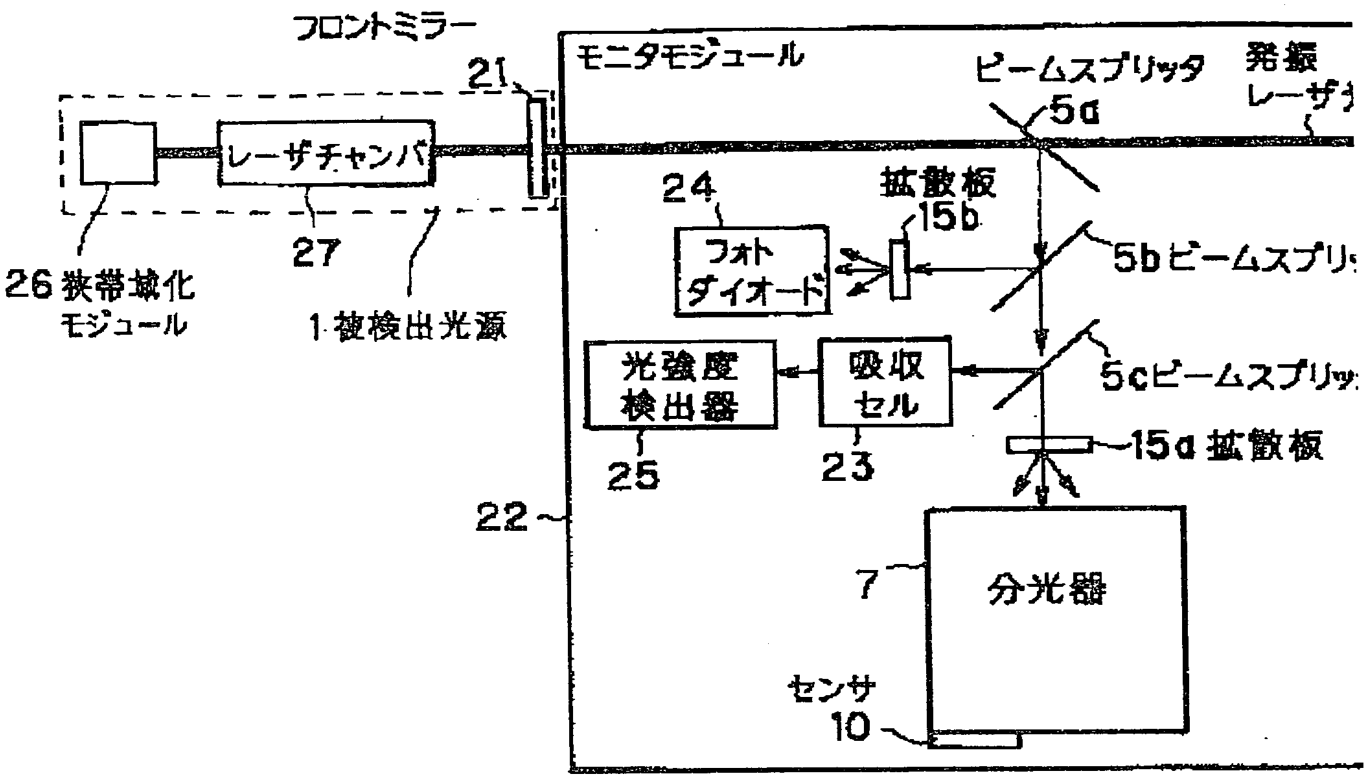


[Translation done.]

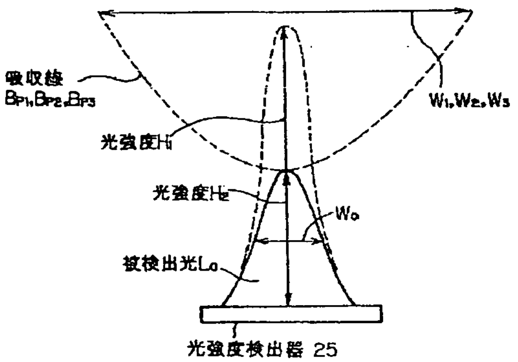
Drawing selection drawing 15



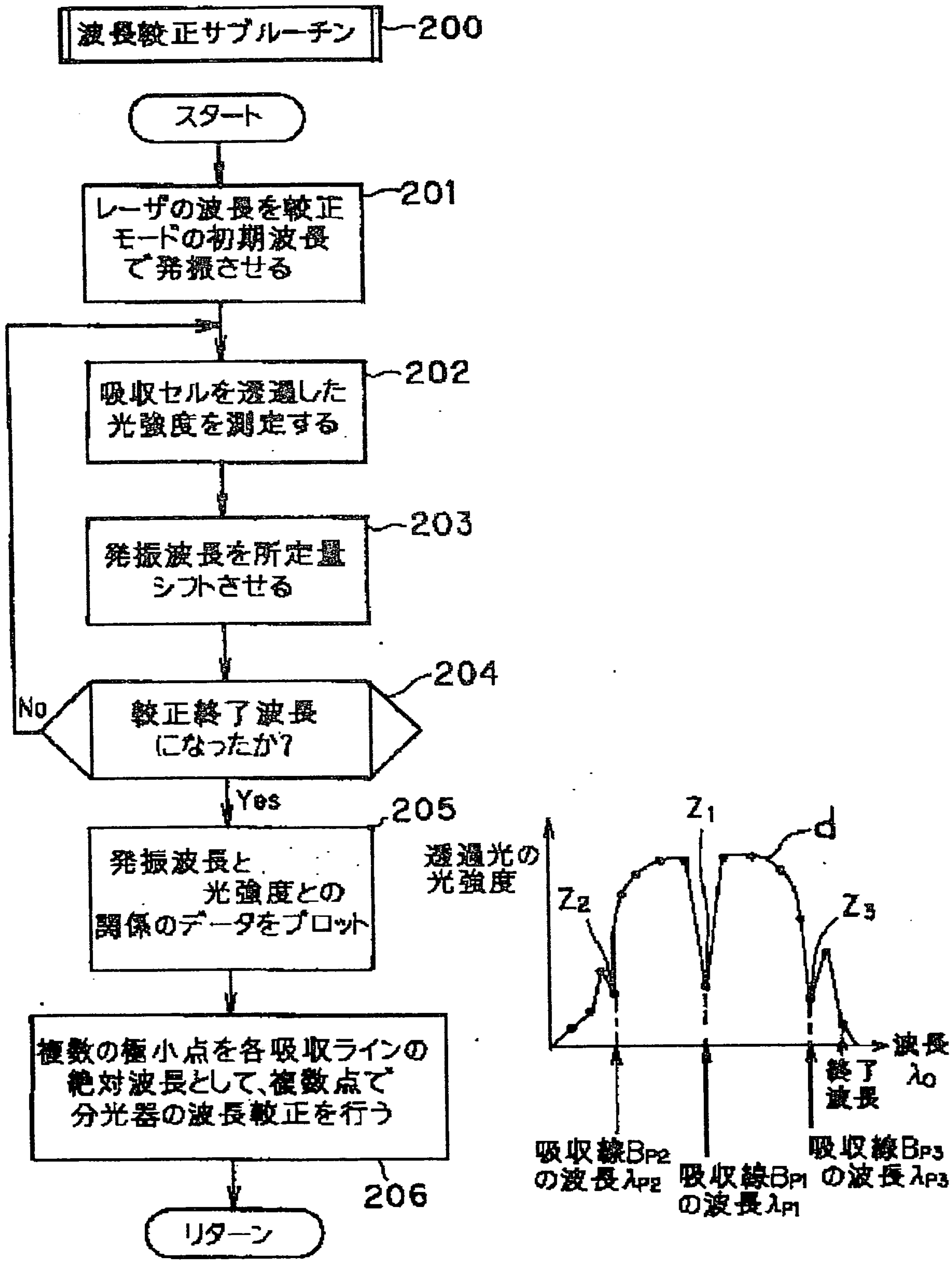
[Translation done.]


フロントミラー
21
モニタモジュール
ビームスプリッタ
5a
発振
レーザ光
レーザチャンバ
24
拡散板
15b
フォト
ダイオード
5b ビームスプリッタ
27
26 狭帯域化
モジュール
1 被検出光源
光強度
検出器
吸収
セル
5c ビームスプリッタ
15a 拡散板
25
23
22
7
分光器
センサ
10

Drawing selection drawing 17

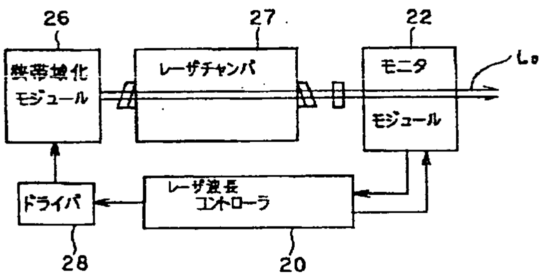


[Translation done.]


波長較正サブルーチン
200
スタート
レーザの波長を較正モードの初期波長で発振させる
201
吸収セルを透過した光強度を測定する
202
発振波長を所定量シフトさせる
203
較正終了波長になったか?
204
No
Yes
発振波長と光強度との関係のデータをプロット
205
複数の極小点を各吸収ラインの絶対波長として、複数点で分光器の波長較正を行う
206
リターン
透過光の光強度
Z1
Z2
Z3
d
波長 λ0
終了波長
吸収線BP2の波長λP2
吸収線BP1の波長λP1
吸収線BP3の波長λP3

(a) (b)

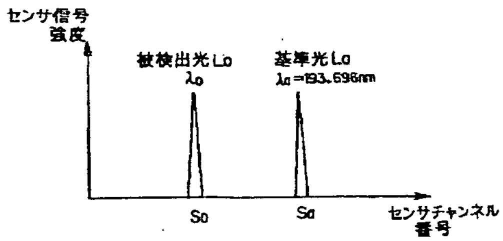
Drawing selection drawing 19



[Translation done.]

Drawing selection drawing 20

従来技術を説明する図



[Translation done.]